WHAT ARE THE BEST ARCHITECTURAL AND DOCTRINAL STRUCTURES FOR THE COMMON GROUND STATION IN ORDER TO PROVIDE THE BEST INTELLIGENCE AND TARGETING SUPPORT TO MANEUVER BRIGADE COMMANDERS? A CASE STUDY OF THE COMMON GROUND STATION FIELDING AT MANEUVER BRIGADES AND THE SUPPORTING ARCHITECTURE AND DOCTRINE

A thesis presented to the Faculty of the U.S. Army
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ABSTRACT

WHAT ARE THE BEST ARCHITECTURAL AND DOCTRINAL STRUCTURES FOR THE COMMON GROUND STATION IN ORDER TO PROVIDE THE BEST INTELLIGENCE AND TARGETING SUPPORT TO MANEUVER BRIGADE COMMANDERS? A case study of the Common Ground Station fielding at maneuver brigades and the supporting architecture and doctrine by MAJ Kenneth J. Diller, USA, 174 pages.

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The most significant benefit that a year at CGSC provides is an opportunity to slow down and to really think about what is currently going on in today's Army and one's own life. This has provided me the chance to step back and seriously take into consideration what we are constantly having fed to us by the various doctrine writers and various schools of thought throughout the Army. Much is good and I believe the overall concepts have at heart the goal of bettering the Army of the future. Although, we cannot and should never (as professionals), take new doctrine or concepts at face value and blindly follow whichever way these various innovations or thoughts attempt to lead us.

I thank all previous leaders that had the faith in my service and contributions to the military and provided me the chance to attend CGSC. Their guidance and wisdom have become the core foundation of my day-to-day life in the Army.

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LIST OF ILLUSTRATIONS

LIST OF ACRONYMS AND ABBREVIATIONS

AFATDS	Advanced Field Artillery Tactical Data System
AFOTEC	Air Force Test and Evaluation Center
AO	Operational Availability
AOA	Abbreviated Operational Assessment
ASAS	All-Source Analysis System
ASCIET	All-Services Combined Integrated Experiment and Test
BM	Battle Management
CALL	Center for Army Lessons Learned
CEP	Circular Error Probable
CGS	Common Ground Station
CI	Counter Intelligence
COTS	Commercial-off-the-shelf (software or hardware)
CT	Contractor Testing
CTT	Commander's Tactical Terminal
DAB	Defense Acquisition Board
DOTE	Director, Operational Test and Evaluation
DUSA	Deputy Under Secretary of the Army
E-8C	Militarized Boeing 707 Aircraft
EW	Electronic Warfare
EXFOR	Enemy Forces
FDTE	Force Development Test and Evaluation

FLOT	Forward Line Of Own Troops
FTI	Fixed Target Indicators
GBCS	Ground Based Common Sensor
GCS	Ground Control Station
GSM	Ground Station Module
GSS	Ground Support System
HMMWV	High Mobility Multi-Purpose Wheeled Vehicle
HUMINT	Human Intelligence
IBN	Intelligence Broadcast Network
IDM	Improved Data Modem
IFSAS	Integral Fire Support Automated System
IMINT	Imagery Intelligence
IOTE	Initial Operational Test and Evaluation
IR	Infrared
JSTARS	Joint Surveillance Target Attack Radar System
JSORD	Joint System Operational Requirements Document
JTT	Joint Tactical Terminal
LAN	Local Area Network
LGSM	Light Ground Station Module
LOC	Line Of Communication
LRIP	Low Rate Initial Production
LUT	Limited User Test

MANPRINT	Manpower and Personnel Integration
MGSM	Medium Ground Station Module
MOS	Military Occupational Specialty
MOTE	Multi-Service Operational Test and Evaluation
MSE	Mobile Subscriber Equipment
MTI	Moving Target Indicators
NATO	North Atlantic Treaty Organization
NRT	Near-Real Time
OEC	Operational Evaluation Command
OJE	Operation Joint Endeavor
OPTEC	Operational Test and Evaluation Command
ORD	Operational Requirements Document
OT	Operational Test/Operational Testing
OT&E	Operational Test and Evaluation
PIR	Priority Intelligence Requirement
PM	Program Manager
RAM	Reliability, Availability, and Maintainability
RFPI	Rapid Force Projection Initiative
RWS	Remote Workstation
SATCOM	Satellite Communication
SAR	System Analysis Report
SAR	Synthetic Aperture Radar
SCDL	Surveillance Control Data Link

SER	System Evaluation Report
SID	Secondary Imagery Dissemination
SIDS	Secondary Imagery Dissemination System
SIGINT	Signals Intelligence
SINCGARS	Single Channel Ground and Airborne Radio System
SS	Sector Search
STU-III	Secure Telephone Unit
TACFIRE	Tactical Fire Direction Computer System
TADIXS-B	Tactical Data Information Exchange System
T&E	Test and Evaluation
TEMP	Test and Evaluation Master Plan
TIBS	Tactical Information Broadcast Service
TOPS	Tactical Operations Support
TRADOC	Training and Doctrine Command
TRAP	Tactical Receive Equipment and Related Applications
TRIXS	Tactical Reconnaissance Intelligence Exchange System
TS	Trojan SPIRIT
TSM	TRADOC System Manager
TTPs	Tactics, Techniques, and Procedures
UAV	Unmanned Aerial Vehicle

CHAPTER 1

INTRODUCTION

> We are adapting our organizational structure, doctrine and equipment to the environment that we will operate in today and in the years ahead.[1]
>
> General Dennis Reimer

The army intelligence community was shaped by nearly half a century of Cold War with the Soviet Union. With the end of the Cold War the community faces extraordinary changes. This and the advent of a technological revolution have affected and will continue to affect the military and army intelligence well into the next century. The primary effects are: a significantly smaller force and decreased budget, with a consistently increasing operational tempo (OPTEMPO). This when coupled with the technological revolution is providing not only the Army but all the services the opportunity to dramatically redesign warfighting and the chance to develop and field the systems used in the wars of the twenty-first century.

Crucial to the changes in doctrine and new systems is the ability to access information and to leverage the new technology to support or be the catalyst in developing the new doctrine. The successful integration of this new doctrine and technology should set the conditions for decisive victory in the future. As stated by the Army Chief of Staff General Dennis J. Reimer, "While our purposes may remain unchanged, Army capabilities must not. Warfare is changing; we must stay in front of that change to be the nation's force of decision."[2]

All services are systematically working towards incorporating these changes and developing the doctrine and systems to take them into the new century. The Army's

Force XXI, the Navy's *Forward . . . From the Sea*, the Air Force's program *Global Reach, Global Power*, and the Marine's with their *Operational Maneuver . . . From the Sea,* are all being developed to design the military of the future.[3] For the Army, the Force XXI central concept is in maximizing technology with the focus on making more information available at not only corps and division levels of command, but also at the brigade and lower echelons.[4]

The United States Army is currently in the process of creating and instituting these new doctrinal, organizational, and technological innovations.[5] With this doctrine, the Army is placing the focus on division and brigade operations. Strike force concepts and smaller, more rapidly deployable forces are the concepts of the future.[6] This change is creating a parallel ripple effect in the Army's intelligence community as it realigns from previous operational doctrine to the evolving concepts of Force XXI.[7] The intelligence community is keeping pace by developing integrated systems and packaging more capabilities into smaller, more mobile systems capable of providing more intelligence to commanders at the lower echelons.

To support these changes, current intelligence doctrine states that the goal is to "enable commanders and operators to attain information dominance over any opponent at all echelons."[8] By providing the full spectrum of intelligence support at the lower echelons, the intelligence community is supporting the Force XXI vision of placing emphasis on the division and the brigade for autonomous operations with Intelligency (Intel) XXI. The goal of Intel XXI is to accomplish the intelligence requirements of providing information dominance to support and enable the Force XXI concept to succeed on any future battlefield. In order to accomplish this goal, significant changes

are taking place in intelligence systems, architecture, and doctrine at all echelons, but most significantly at the maneuver brigade levels.[9]

A New Structure

Based upon the Force XXI tenants, maneuver brigades will be expected to dominate frontages of 18 to72 kilometers, to a depth of 15 to 100 kilometers. The concept is that the Force XXI heavy brigade can operate across the total range of combat operations ranging from peacekeeping operations to decisive heavy combat operations. It outlines that the brigade will use firepower, maneuver, and information dominance to destroy the enemy. Overall, the basic concepts of brigade operations remain the same as those outlined in the current Field Manual (FM) 71-3, *Brigade Operations*. The impact of Force XXI and Intel XXI is that current and developing technologies will enhance the brigades situational awareness. This will be done by moving all types of information "by automated means, so decision making, maneuver and employment can be conducted rapidly," allowing the brigade to not only set the conditions for success, but to dictate the overall flow of each engagement.[10]

To support the Force XXI concepts, the army intelligence battlefield operating system (IBOS) is being restructured.[11] The IBOS centerpiece in this structure at the brigade level is the Common Ground Station (CGS).[12] Initially developed as the Army's downlink to the Joint Surveillance Target Attack Radar System (JSTARS) airborne collection system, the CGS has evolved into a system that the Army's intelligence community is flaunting as the intelligence processor at division and brigade headquarters that will support many of the Force XXI initiatives.

Intelligence doctrine developed to support the need for more and faster intelligence, specifically at the brigade level, has also resulted in a more robust intelligence direct-support company. This company key elements include the ground surveillance radar (GSR), improved remote battlefield sensors (IREMBAS), interrogators, counterintelligence agents, a fleet of outrider unmanned aerial vehicles (UAV) with the control and downlink element ground control station (UAV GCS), the CGS, and an analysis and control team (ACT).[13] This new structure includes not only an interface with additional collection systems, but for the first time provides the brigade with the all source analysis system (ASAS) and a robust analysis team with a significant increase in analytical support. Overall, this company supported by the CGS and in direct support of the brigade's intelligence staff officer (S2), provides a significant increase in intelligence capability at the brigade level.[14]

As the Army moves towards fielding over one hundred CGSs throughout the Army at all echelons, the intelligence community is attempting to finalize the integrated intelligence architecture and supporting doctrine for this system.[15] The emerging CGS tactics, techniques and procedures (TTP), evolving Army doctrine (Force XXI), changing intelligence doctrine and architecture (Intel XXI), and the new intelligence support structure highlight that the challenges for the Army, the intelligence community, and the developers and users of the CGS are significant and challenging.[16] Development of both adequate doctrine and architecture are critical in ensuring success in the future.

Background (JSTARS)

JSTARS and the ground station module (GSM), the precursors to the CGS, emerged upon the military with a "bang" during Desert Shield and Storm. After a short

trial/test conducted in Europe, JSTARS with two planes and six supporting GSMs were deployed to the desert. Flying primarily at night, the system provided critical intelligence utilized by all ground component commanders during the air and ground phases of the war. Leaders at all echelons praised its performance. As stated by the Army G2, BG John F. Stewart, "The Joint Surveillance and Target Attack Radar System was the single most valuable intelligence and targeting collection system in DESERT STORM."[17] In the end, the performance exhibited during the Gulf War ensured future production of the two critical components of JSTARS the Air Force's E-8C and the Army's associated ground station.[18]

The JSTARS program began as the result of the consolidation of separate Army and Air Force moving target indicator (MTI) programs. The Air Force was pursuing a system known as Pave Mover that provided MTI and SAR surveillance, and included a weapons guidance mode that could guide tactical aircraft or missiles to targets. The Army had built a system called SOTAS, a helicopter-based, MTI-only system that had run into cost and technical problems during full scale development. In 1982, the Undersecretary of Defense for Research and Engineering (USDRE) combined the SOTAS and Pave Mover efforts into a joint program, later designated JSTARS. The Air Force was designated as the lead service responsible for coordination and integration of the overall JSTARS program, and for developing and producing the airborne collection system.[19] The Army, as the participating service, was assigned responsibility for the development of the ground station providing a direct downlink from the plane. Both services conduct ongoing coordination to ensure that the air and ground components of the system remain compatible.[20]

The current JSTARS system includes both the airborne and ground segments. The system's primary capability is in maintaining radar coverage over the battlefield during extended periods of time. The system conducts radar coverage, tracking and identifying slow-moving ground targets (referred to as moving target indicators (MTIs)), and provides synthetic aperture radar (SAR) imagery of any area in radar coverage footprint. (See fig. 1.)[21]

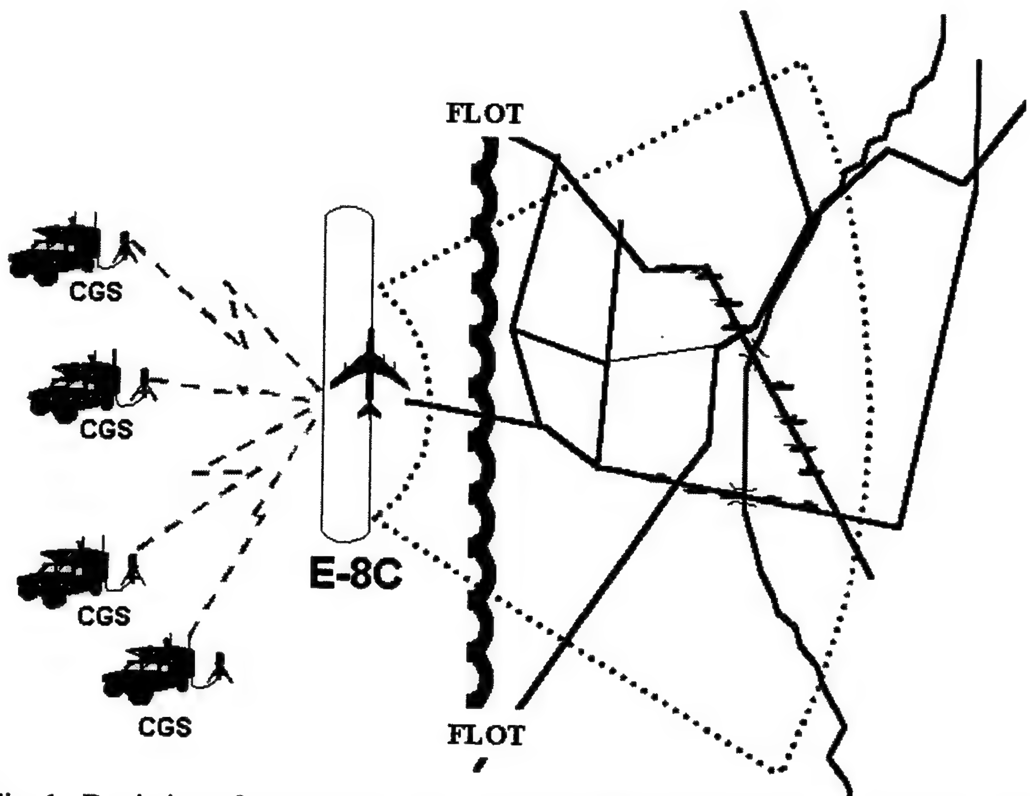

Fig. 1. Depiction of an E-8C in orbit, the side looking airborne radar coverage area, and the location of the CGSs in relationship to the E-8C. The E-8C flies a standard track at an altitude of approximately 30,000 feet. As the E-8Cs radar covers the ground radar coverage area (GRCA), the imagery data is passed to the CGSs located at the various ground component headquarters. MTIs depict the location on the operator's screens showing the location and speed of movement of threat vehicles. Source: Graphics provided by USA OPTEC, CGS Test and Evaluation Team on 15 October 1998.

The E-8C airborne collection platform consists of the following major subsystems: the aircraft, radar, an operations and control subsystem, and a communications subsystem. (See fig. 2.) The twenty six-man crew on the aircraft (including the pilots, navigators, and contract support team) controls the radar, interacts with the army ground stations, and monitors the returns depicted on the eighteen computer workstations located on the plane in order to satisfy requirements from ground and other commanders.[22]

Fig. 2. Image of the E-8C aircraft. (Note the radar dome beneath the aircraft.) Source: Graphics provided by USA OPTEC, CGS Test and Evaluation Team on 15 October 1998.

The E-8C transmits the multimedia radar imagery data near real time to the ground stations.[23] The CGSs deployed at brigade through theater headquarters and located within line of site of the aircraft receive the imagery data via the surveillance and control data link (SCDL).[24] The CGSs request specific areas or types of imagery from the E-8C, which the radar operators process and answer the request by imaging the requested area and then transmitting the imagery to all ground stations.

Background (CGS)

Since the late eighties, the Army has developed a series of ground stations with incrementally improved capabilities. The intermediate ground station module (IGSM) was the first ground station fielded. It provided support during Desert Storm and was subsequently fielded to the XVIII Airborne Corps. The next variants were the light ground station module (LGSM) a highly mobile and multipurpose wheeled vehicle (HMMWV) variant primarily fielded to III Corps and the Medium Ground Station Module (MGSM) five-ton truck variant fielded to Korea, 513th MI BDE, XVIII ABN Corps, and III Corps.[25]

The latest and final version to be fielded is the CGS (AN/TSQ-179) which has been enhanced from previous versions not only to incorporate the imagery downlink function from the E-8C, but also to serve as a "common" system capable of supporting all echelons with intelligence links from several different sources.[26] The goal of the intelligence community was to develop an intelligence pre-processor capable of processing and correlating information from different real-time sensors. The CGS is intended to be the backbone of intelligence support at the brigade level.

The current CGS system is composed of a HMMWV mounted with the multipurpose mission shelter, housing two operator workstations, digital and voice radio communications, map digitizer, and room for three soldiers to conduct mission operations. (See fig. 3.) Power to operate the system is provided by two 10-kilowatt, tactical, quiet generators mounted on two cargo trailers. One four-seater (command variant) HMMWV is the support vehicle that assists in moving the six-man crew, personal gear, and repair parts.

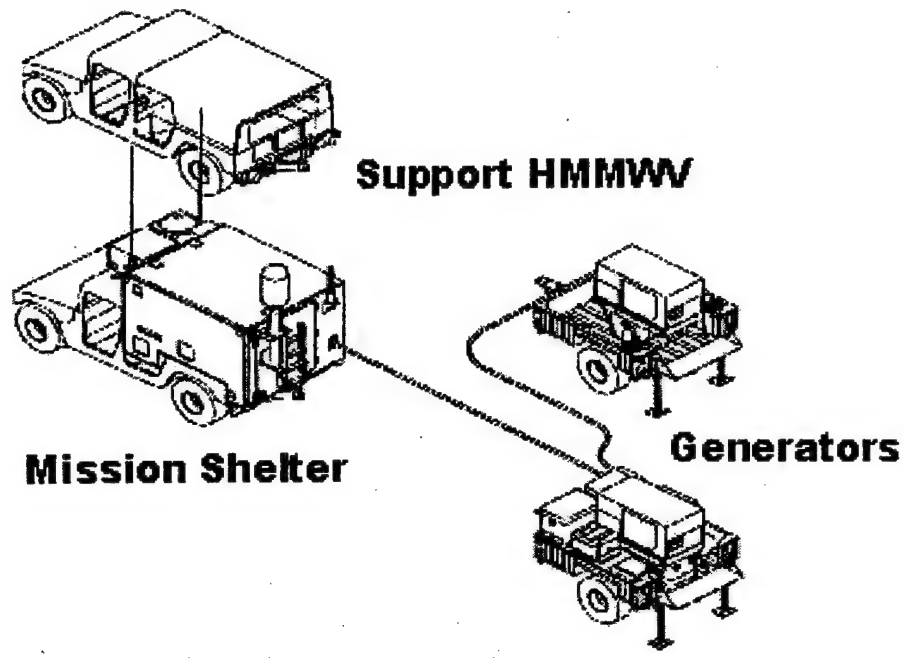

Fig. 3. Common Ground Station. Source: Graphics provided by USA OPTEC, CGS Test and Evaluation Team on 15 October 1998.

In interfacing with the E-8C, the CGS receives radar imagery data via the SCDL link and passes radar service requests (RSR) from the CGS to the E-8C via the same path. (The CGS crew can also talk to the E-8C crew by voice with a ultra high frequency (UHF) radio.) The CGS crew, based upon intelligence requirements developed by the S2, requests the E-8C to collect and pass synthetic aperture radar or moving target indicators imagery to the CGS. While the CGS crew has no direct control over the collection platform, requests are passed from the CGS to the E-8Cs onboard army crew to have the E-8C provide increased focus in an area or to have different types of coverage initiated to provide required imagery for the ground commander.

Key to the JSTARS interaction between the E-8C and the CGS is the basic products (imagery) the E-8C provides to the CGS. The radar operator on the E-8C can

change radar modes depending on requirements from the ground component commanders, or the specific CGS operators. The primary modes are moving target indicators or synthetic aperture radar imagery (literal image of the area). (See fig. 4.) The MTI mode can be focused on to a specific area providing enhanced detail on moving targets in order to provide the detail required to support targeting or analysis.

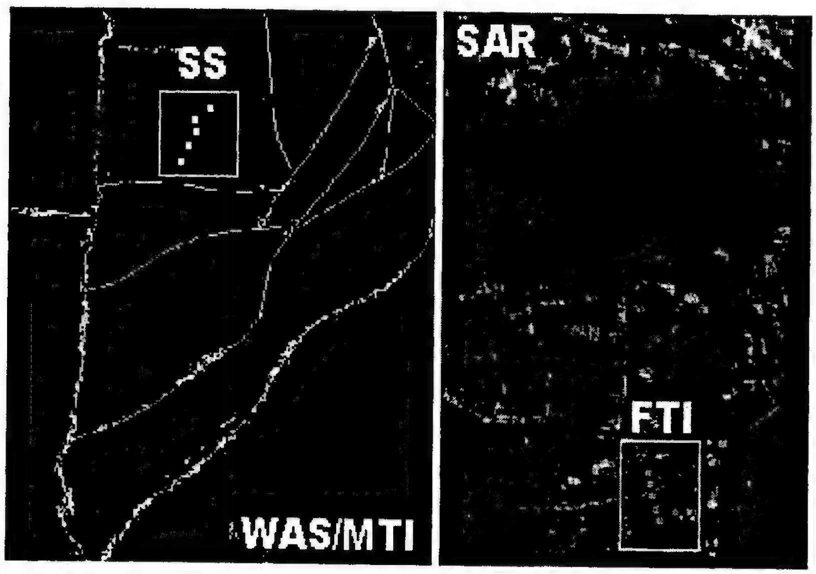

Fig. 4. Imagery products as displayed on a CGS operator screen. Source: Graphics provided by USA OPTEC, CGS Test and Evaluation Team on 15 October 1998.

The significant change to the CGS as compared to previous Ground Stations is the ability to simultaneously receive and correlate several other intelligence products. The CGS has several interfaces capable of receiving raw or processed intelligence. Interface with other collection systems includes: (1) the previously discussed capability to receive JSTARS imagery MTI and SAR; (2) signals intelligence (SIGINT) via the intelligence broadcast network (IBN) through the commanders tactical terminal (CTT); (3) imagery

from corps, theater, and national technical sources; (4) UAV imagery and telemetry via a hardwire connection with the UAV ground control station; (5) SECRET Internet Protocol Router Network (SIPRNET), or intelligence link (INTELINK) via the trojan special purpose integrated remote intelligence terminal (Trojan SPIRIT); and (6) sending or receiving data from the new army attack helicopter, the Apache LONGBOW. The capability to pass intelligence to processing systems is possible with the all source analysis system (ASAS) and the advanced field artillery targeting data system (AFATDS), other CGSs, and further dissemination to other software compatible systems via tactical or theater communications networks or via the Trojan SPIRIT. (See fig. 5.)

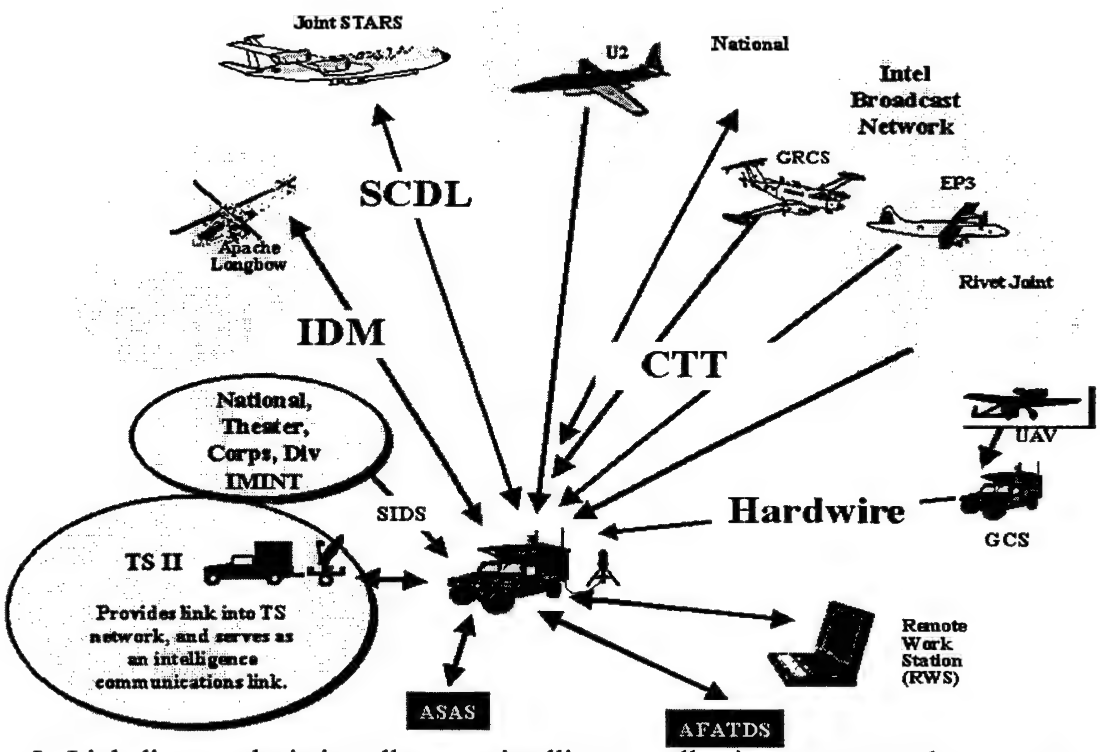

Fig. 5. Link diagram depicting all current intelligence collection systems and processors with which the CGS interfaces. Source: Graphics provided by USA OPTEC, CGS Test and Evaluation Team on 15 October 1998.

The capabilities described above allow the operators to perform the key processes to receive, simultaneously store, and display sensor data from the E-8C, imagery from the UAV, Secondary Imagery Dissemination (SIDs) products from various sources, and SIGINT received from IBN. These capabilities are designed to provide the functions of, surveillance, battlefield management, and target development support to the maneuver brigade staff.

While the primary collection platform remains the E-8C, the Army has created a common system capable of interfacing and correlating several different intelligence sources. This aspect, when coupled with planned fielding of this system to the maneuver brigade, is a significant change in tactical intelligence architecture and doctrine. Given these significant technical changes and fielding concepts of the CGS, as compared to both the previous versions of the ground station and corresponding tactical doctrine, development of current adequate doctrine and applicable architecture is the key for the future success of the system and tactical intelligence as a whole.

Numerous discrepancies with the current supporting doctrine and architecture designed to integrate the CGS into the Army have been noted through various operational testing of the system (specifically at the division and brigade echelons). The ground stations have only been fielded to four different organizations, with no more than twelve total systems fielded at any one time, and no systems ever having been fielded to brigade echelons.[27] Therefore, experience in the Army with the system and its utilization has been limited with little quality thought given to determine the best means to field, deploy, and operate the CGSs. While the Intelligence Center and School has developed the initial TTP for this fielding and support, significant questions and concerns reference the

developed doctrine and architecture (interfaces) remain.[28] These issues are the focus of this thesis.

The goal is to determine the best doctrine and architecture in order to present an alternative to the currently proposed plan. The author's intent is to present alternatives to existing doctrine and architecture based upon an analysis of the existing doctrine and TTP. The intent is to determine issues and present recommended changes which will maximize intelligence and targeting support to the maneuver brigade staff.

Purpose of this Thesis

This thesis will explore the intelligence doctrine and architecture related to the CGS supporting Army maneuver brigades. The purpose is to determine the best architectural and doctrinal structures for the CGS, in order to provide the best intelligence and targeting support to maneuver brigade commanders. In order to address the stated purpose, this thesis will examine the new doctrine and architecture developed by the Intelligence Center and School based upon models that depict the integration of the CGS into the brigade's intelligence system in relation to the three key functions of the CGS. Based upon an analysis of the models, taking into account external impacts to both the doctrine and the CGS, the author will develop issues which must be addressed in order for the CGS to be effective.

The supporting questions will form the structure for conducting the analysis of the CGS. These supporting questions will be used as an aid in developing and analyzing the models, which will be the basis for evaluating the current doctrine and architecture. In order to do this a wide range of various documents and current articles related to Force

XXI, Intel XXI, the CGS, test reports, TTP, and doctrine to adequately address the following areas:

1. What is the connectivity (key nodes, links and arcs) of the CGS as part of the intelligence system in the maneuver brigade? This question is essential as the starting point in developing a node and link model of the CGS as part of the brigade internal intelligence system. The development of the models to answer this question is key in answering the following subordinate questions and the overarching primary question.

2. What information or data does the CGS send or receive as part of the brigade's intelligence system. This question addresses the method by which the CGS is tasked and the format or method the CGS provides and displays information or data to the different users. (Answering this question after the completion of the first question will form the basis of the study, significantly assisting in answering the remaining questions.)

3. Has the Army built a successful system capable of processing and delivering intelligence in support of the Army Force XXI constructs in respect to brigade operations? The technical development and the logic behind this development and its integration into the system will be examined. This will be done in order to: (1) determine if the Army has technically developed a system capable of providing the required support at brigade level to support the staff and commander based upon the functions associated with the Force XXI doctrine for brigade echelon;[29] and (2) to determine if the existing technology and doctrine support the tenants of Intel XXI?

4. Is the existing connectivity (architecture) of the CGS adequate to receive intelligence feeds and disseminate information to users as outlined in the existing CGS architecture and doctrine? This area will be analyzed in order to determine if the doctrine

and the architecture are adequate to incorporate all intelligence data available to the CGS (as discussed in the introduction). This will also determine if the links from the CGS to the processors (ASAS, AFATDS, and others) as currently designed (for both architecture and doctrine) are adequate.

5. Is the current CGS doctrine adequate for supporting the ACT and brigade staff at brigade level? The ACT concept is a new concept and is still in the process of being incorporated in maneuver brigades in the different divisions. The ACT, as the intelligence production element for the brigade, has as its key elements the CGS and ASAS. The doctrine, related to the incorporation of the CGS in regards to ASAS and the other systems supporting the ACT, is critical to the overall success of not only the CGS, but also the intelligence ACT concept at the maneuver brigade level.

6. Can the CGS and crews provide the right intelligence, when required, in the format required? This area is critical to determine whether the information from all the intelligence collection systems that support the CGS is timely and is presented in a useable form for the CGS crews and supported staff. One aspect in addressing this question will be to determine if the information provided by the CGS needs to be analyzed prior to being disseminated for production or sent directly to the various users as information or raw intelligence. In order to answer these questions, the key intelligence areas of collection management, processing, analysis, and dissemination procedures in relation to the CGS operations will be analyzed. The results of the analysis of these four areas are not only key in answering this supporting question, but also in determining the best supporting doctrine and architecture required for the CGS to be successful.

A secondary aspect of this subordinate question is to determine if the correct mixes of soldier skill specialties are (per doctrine) assigned to operate the system. Currently the system is manned by military occupational specialty (MOS) 96H. This MOS is basically trained as operators, who receive only precursor training in the ability to conduct analysis of the information processed by the CGS. Alternatives discussed previously in the intelligence community raise the possibility of including intelligence analysts, imagery analyst, and signals intelligence analysts or of a combination or mix of each specialty.

7. Can the CGS provide adequate surveillance, targeting, and battlefield management information to the supported commander and staff? The primary functions of the CGS are to support surveillance, targeting, and battlefield management functions for the supported staff. This issue must be addressed in order to determine whether the doctrine, architecture, and system (technically) are capable of supporting these three critical functions.

Scope

The three principal functions that the CGS brings to the maneuver brigade are support to surveillance (intelligence), targeting assistance, and battle management support. The CGS, in providing this type of support in conjunction with the new ACT concept at maneuver brigades, provides a significant increase in collection and processing of both raw and preprocessed intelligence at the tactical echelon. Therefore, the proposed doctrine and architecture are critical for future success and acceptance of this new intelligence concept. This concept and its ability to provide required support in this era of shrinking resources, changing doctrine, and emphasis on doing more with less are

critical in the future of tactical intelligence soldiers, capabilities and processes supporting the new Force XXI doctrine and supporting intelligence concepts.

In order to determine the best architectural and doctrinal structures for the CGS to provide support at the brigade echelon, this thesis will focus on three critical areas. These areas are: (1) the key functions of the CGS; (2) external impacts, such as collection systems and development of new Army and intelligence doctrine; and (3) "key intelligence functions" of directing, collecting, processing, and disseminating.

Assumptions

Data for this thesis includes historical studies and different tests conducted by military test and evaluation organizations and observations and results from the advanced warfighting experiments (AWE) and other military exercises in which a CGS or a CGS prototype were utilized. Data relevant to Force XXI and Intel XXI, collection systems to other external impacts are and will continue to change as the concepts are validated or changed. Therefore, several assumptions must be made in order to establish a solid starting point for this thesis during this era of constant change in both technology and doctrine.

1. Validity of tests and studies: The results gathered and documented during these tests and exercises are assumed to be valid and will be utilized to form the basis of an understanding of the technical capabilities of the system. Current capabilities and shortcomings (technical and doctrinal) of the CGS have been documented based upon tests, evaluations, and the results of exercises over the past two years. The majority of these are documented by the Operational Procurement Test and Evaluation Center (OPTEC) or by the training and doctrine command (TRADOC) during several

evaluations of AWEs. These organizations conducted extensive technical and operational testing of the system in both the laboratory and in the field.

2. Changes in doctrine: Some minor changes are to be expected in Force XXI, Intel XXI, and intelligence-support doctrine at the brigade level, although any future changes are assumed to be minor and will not effect the overall outcome of this thesis. Doctrine is constantly evolving. Since this thesis is constructed utilizing historical, current, and estimated capabilities, to either support or disprove adequacy of support at the brigade level, this thesis assumes that the currently proposed Army and intelligence doctrine (to include the ACT concept) will not change significantly prior to the CGSs being fielded.

3. Current fielding status of the CGS: Based upon previous experience with the system and the acquisition process, it is assumed that the CGS will be fielded into the overall force structure as currently designed, with only minor modifications. The CGS has not been authorized for full development or fielding pending results from the follow-on operational test (FOT&E) to be conducted in February1999 at the Motorola facility located in Phoenix, Arizona. Initial results from the initial operational test and evaluation (IOT&E) showed several significant shortcomings, specifically in the area of system availability and ability to conduct surveillance and targeting support at all echelons. Even though, conditional fielding has been authorized by the Army for five systems to be fielded to Fort Bragg and to Fort Hood.

4. Ground based common sensor (GBCS) non-fielding: Based upon numerous problems resulting from the ongoing testing of the GBCS, an assumption was made that GBCS will not be fielded for several years. Therefore, the GBCS scheduled for fielding

in 1999 will not be considered in this thesis. This assumption is based on the fact that the GBCS is in serious trouble in not being capable of conducting SIGINT operations as outlined in the *GBCS Operational Requirements Document*.[30] This is an intelligence system that the intelligence community has been promoting since the early nineties. The GBCS is an electronic intelligence (ELINT) and communications intelligence (COMINT) collection system and processor, which will be fielded as a set of six systems to each division.[31] If the GBCS is ever fielded, it will be fielded with a significantly lessened capability or will not be fielded for several years, well outside of the scope of this thesis.

5. UAV. For the purpose of this study, the assumption is made that the Outrider UAV will be the Army's brigade short range UAV in the near future. The UAV program in the Army has been and apparently continues to be in a constant state of uncertainty. Previous testing conducted with the CGS and previous models of UAVs have demonstrated interconnectivity with the Hunter and Predator UAVs.[32] With similar technologies utilized in each of these UAV programs, a second related assumption is that the Outrider UAV will have corresponding interconnectivity with the CGS as demonstrated with the Hunter UAV during the CGS IOT&E, and with proof of concept test with Predator during Operation Joint Endeavor (OJE).[33]

6. Future battlefields. Based upon the capabilities of the collection systems that provide information to the CGS, it is necessary to determine the type of threat a mechanized or armored maneuver brigade will face in the future. Based upon studies conducted by both TRADOC and the Intelligence Center and School, the assumption is made that "battle between mechanized forces [in the future] will be similar to armored

operations of the past three decades."[34] This validates the fact that current collection system which "feed" the CGS will still have "the capability" of locating and tracking enemy mechanized or armored elements.[35]

Definition of Key Terms

Because of the technical nature of this thesis, the required list of definitions required is extensive. But, because of the newness of the current doctrine and the technical nature of the system and the significant changes being made in both intelligence and Army doctrine, a basis of understanding is required. Due to the technological revolution the Army is involved with, there are many new and unfamiliar terms and phrases which demand description and common understanding. Also, because of the drastic rate at which new terms are being generated, certain terms used in this thesis may be out of vogue or not make the future cut. The following terms, therefore, are defined in order to establish a common understanding for both the reader and the writer and will be parameters for the author during the development of the thesis.

ARC. This is the second term used in the discussion and analysis of the models. ARC refers to an alternative or noncommon link that may occasionally take place among nodes causing a change from the original process outlined in the model.

Architecture. For the purpose of this thesis, architecture relates to the interconnectivity, such as communication links, collector links, and others which create the structure of the intelligence system. This includes interface with collection systems, other preprocessors, and processors. Because of the ongoing dramatic changes taking place in the intelligence community, the definitive line between doctrine and architecture

is quickly becoming blurred. Therefore, on occasion the two terms relate to the same concept or process.

Army Battle Command System (ABCS). This is the overarching system that integrates five systems, which share information, digitizing the information for quick and ready dissemination, correlation and use by the commander and staff. A component of ABCSS are the five battlefield functional area command and control systems (BFACS) which provide situational information and decision support to commanders and staff during the conduct of tactical operations. The BFACS include the maneuver control system (MCS), the advanced field artillery tactical data system (AFATDS), the all-source analysis systems (ASAS), the forward area air defense command and control intelligence (FAADC2I) system, and the combat service support control system (CSSCS).

CGS. The CGS and its capabilities have been defined previously. When used in this context, it is referring to the current system that is the focus of this thesis.

Doctrine. This refers to the written or standard process by which systems, operators, and other activities are used or conducted to successfully establish a basis of commonality between systems, users, and overall operations in order to win battles and wars. On the verge of integrating Force XXI concepts, the immeasurable means by which information and intelligence can be moved, and the different methods to do this fall under this definition. Therefore, as stated in the architecture definition, the difference between the two terms (architecture and doctrine) is becoming increasingly transparent. TRADOC's definition, based upon the *TRADOC 1998 Quarterly Update* states:

> Doctrine lies at the heart of a military force's professional competence. It is the authoritative guide to how forces fight wars and conduct operations other than war. Never static, always dynamic, doctrine is firmly rooted in the realities

> of current capabilities. At the same time, it reaches out with a measure of confidence to the future. Doctrine captures the lessons of past wars, reflects the nature of war and conflict in its own time, and anticipates the intellectual and technological developments that will bring victory now and in the future.[36]

Ground Station. This term will be utilized to reference the generic Army ground station for the E-8C. It is an inclusive term and relates to the generic system developed as the ground downlink station for the E-8C. This term will be used when referring to previous versions of the CGS, such as the IGSM, MGSM, and LGSM, specifying the ground component of the Joint STAR System.

Information and Intelligence. It is important to delineate a clear distinction between information and intelligence. Information is data that has been collected but not further developed through analysis, interpretation, or correlation with other data and intelligence. The application of analysis or correlation with other data transforms information into intelligence. Intelligence is the product that can readily be used by a commander and staff in the execution or planning of tactical operations. These two distinctly different words are used to imply their specific meaning throughout this thesis.

Information Dominance. This refers to one of the six critical aspects of the Force XXI concept, and its understanding is critical in understanding the intent of the increase in size and capabilities of intelligence collection at the maneuver brigade. The current definition as defined by FM 100-6 states: "The degree of information superiority that allows the possessor to use information systems and capabilities to achieve an operational advantage in a conflict or to control the situation in operations other than war while denying those capabilities to the adversary."[37]

Intelligence System. For the purpose of this study, this term refers to the brigade's internal system, which directs, collects, and produces intelligence for the staff and commander. This includes the links and nodes that are involved in the directing, collecting, processing, and disseminating intelligence. Because of the complexity of the digital division, in some cases, external collection systems or nodes may temporarily impact or be part of this intelligence system.

JSTARS. Reference made utilizing this term will relate to the entire system, including both the E-8C and the CGS.

Links. This is the third term used in the discussion and analysis of the models. Link refers to the standard interconnectivity or message flow in the process outlined in the models.

Node. This term is used as a subcomponent of the models developed for the conduct of analysis. Node refers to a collector, preprocessor, processor, user, or other element which receives information, requests information or in some means impacts the flow of information coming from the CGS, or affects the operations of the CGS by some means. A node can be considered as a point where information from two or more systems merges.

Preprocessor. This is another term that has not been incorporated into intelligence current intelligence doctrine. Preprocessor is a system that manipulates information received from the collection system prior to passing to the processor as defined above. The CGS, UAV GCS and typically any downlink system are examples, and can be categorized as pre-processors since intelligence is subsequently passed to the ASAS (the processor).

Processor. In this thesis, processor will refer to the ASAS and AFATDS. While this term is not officially defined in any intelligence manual, it is commonly utilized in the intelligence community to refer to a system which processes and correlates raw intelligence received from a collection system or systems. Typically ASAS falls into this category and is often referred to as the intelligence processor.[38]

Limitations

The most significant challenge in the development of this thesis is the real-time development of doctrine and testing results concurrent with the writing of this thesis. A significant amount of information referencing Force XXI and Intel XXI became available during various phases of the preparation of the thesis. (Definitions and concepts were being developed and altered at an incredible rate during the period of late 1998 and early 1999.) Since the content of this thesis is intended to be timely, forward looking, and applicable immediately upon its completion, the writer utilized available published documents or test results dated earlier than 1 February 1999 in order to conduct a timely and accurate study.

The exclusion of classified material had a minor impact on the construct of this thesis. Not using available classified material impacted specifically when study was conducted in the areas of the collection system capabilities and on the joint concept of operations (CONOPS) developed between the Air Force and Army reference utilization of the E-8C in support of Army ground forces. The overall capabilities of the CGS as a whole, regardless of information provided, are unclassified. Because of the intended goal in determining and justifying the best doctrine and architecture, the exclusion of classified material had only a limited impact.

The doctrine for the JSTARS, the CGS, and the Army's utilization for the system is (and has been) in a constant state of rewrite for the past two years. The projected completion date for several documents to include the "Tactics, Techniques and Procedures for the Common Ground Station" is April 1999. The Air Force's 93rd Wing is also working on a "Users Manual for Effective Use and Management" of JSTARS with a projected publish date of early 1999. The author received draft copies of both and will utilize these as the initial starting point in studying the doctrine. Neither document was completed or approved by the respective authorities prior to the completion of this thesis.[39] This did not impact the overall outcome of the analysis since the overall structure of the brigade organization and intelligence support element will not drastically change in the near term.

One significant shortcoming is the delay in publication of the 1998-1999 version of FM 100-5. Originally scheduled for publication in 1998, the new publication date is scheduled for Fiscal Year 2000. This document would have been invaluable in providing a structure in that the new FM 100-5 deals with the Force XXI concept of operations at the lower echelons. As stated in a TRADOC update: "Much of what was written [in the new FM 100-5] described the tactics of battalions, brigades, and divisions rather than supporting an operational focus."[40]

The initial operational test and evaluation of the CGS was completed in May 1998. The results indicated that the system was not capable of being sustained, providing accurate targeting information, and in providing surveillance information. The Director of Operational Testing and Evaluation (DOT&E) and the Deputy Under Secretary for the Army, Operations and Research (DUSA (OR)), directed that a follow on phase of testing

be conducted at the Motorola plant in Phoenix to give the program manager (PM) and the TRADOC system manager (TSM) an opportunity to fix these significant problems. Results of this testing will have a minor impact in conducting an analysis of the capabilities of the system (primarily the capability to locate fixed and moving targets, relating to both surveillance and targeting). Therefore, intermediate draft documents on the results of this follow-on test were incorporated as required.

Relatively few documents or studies exist which provide examples of methods for analyzing intelligence preprocessors or processors. The majority of studies located focussed primarily on analyzing collection systems or the intelligence process as a whole used to support targeting. To overcome this limitation, a combination of examples previously conducted on intelligence collection systems and intelligence systems as a whole to develop a relevant research model were utilized.

Delimitations

The purpose of the research is to determine the best architectural and doctrinal structures for the CGS to provide the best support at the brigade echelon. To do this, the research and outcomes are limited to: (1) the key functions of the CGS (surveillance, targeting, and battle management) in providing support at the maneuver brigade, (2) collection systems that provide intelligence to the CGS, and (3) connectivity and information passed and received by the CGS.

1. CGS key functions. The scope of this thesis is restricted to focusing on the intelligence, targeting, and battle management support provided by the CGS at the maneuver brigade. Since these three areas are the key functions of the system and the most significant capabilities the CGS provides to brigade commanders, each will be

examined based upon a model to determine whether the system is capable of supporting and executing each function as affected by internal and external impacts.[41]

2. Collection systems. Since the E-8C is the "primary" collection system for the CGS and provides the most timely information in regard to surveillance and targeting, significant reference of this relationship for utilization of the system as a whole will be reviewed. While the E-8C is critical, all interfaces utilized by the CGS and (as required) other intelligence and targeting systems supporting the Army at maneuver brigade level will be discussed and analyzed.

3. Intelligence functions. The four standard intelligence functions (part of the intelligence cycle) are used to form the basic components of the model utilized to conduct the analysis and to answer the subordinate and primary questions. These are directing, collecting, processing, and disseminating intelligence information and products. (Development and use of the models are discussed in depth in chapter 4.)

4. Scenarios. In conducting the early stages of analysis, the author determined that it was necessary to further limit the scope of the thesis in regard to potential future deployments or scenarios involving a CGS supporting a maneuver brigade. Therefore, the author limited the scope by taking into account potential scenarios that involve only mid-to-high-intensity conflict when the brigade is deployed as part of a division. (During the conduct of the analysis, when a issue with a significant impact on other types of operations became evident, the author took exception to this limitation and briefly addressed the relevant issue.)

5. Peacekeeping operations: "JSTARS in Bosnia is like a nuclear submarine in Kansas: a great weapon system in the wrong environment."[42] The use of JSTARS in

peacekeeping operations will not be included as part of this study because of the complexity and additional issues potentially raised. Basis for this decision is related to the fact that JSTARS was deployed in support of Operation Joint Endeavor during two separate deployments. Deployed with high expectations, the overall results were disappointing for the Air Force, Army, and coalition commands. Because of the terrain, weather, heavy vegetation, and intermingled movement of both civilian and military vehicles, the system's utility was significantly limited.[43] (Although, the past and future use of the CGS in peacekeeping operations, or low intensity type operations warrants and is worthy of a separate study.)

Significance of this Study

> Information technologies are of military value only to the extent that they are accompanied by coherent doctrine, organizations, equipment and people--to say nothing of the time needed to make them function as a team.[44]
>
> TRADOC Pam 525-69

New concepts, revised doctrine, and enhanced technical capabilities are being introduced at a critical time in the Army as it reorients and prepares itself to fight in the twenty-first century. With the development and implementation of the new Army Force XXI, development of the supporting intelligence doctrine in the form of Intel XXI, incorporation of the technical capabilities of the CGS, and in supplying this capability to the maneuver brigade, the Army is entering a significant period dramatic change.

Technically, the CGS, in evolving from previous versions of the ground station, has matured into a common or "system of systems" tool. It is capable of receiving intelligence (primarily SIGINT and IMINT) from a variety of sources and disseminating

this information to a multitude of users. In the technical development and the upcoming operational fielding of the CGS, the Army states that this is the last evolutionary step in the development of ground stations. This final evolution and the fielding of this system to the maneuver units provides brigade commanders (for the first time) links to several collection systems, and the first ever significant support to intelligence processing and production capability for the brigade.

With the incorporation of Force XXI and supporting intelligence doctrine into the Army over the next several years, now is the time to review key components of this architecture and doctrine. The author, in focusing on the CGS at the brigade level, is conducting a study on a single key component of the intelligence doctrine evolving in support of Force XXI. The new architecture and doctrine developed to integrate the CGS into the ACT concept at maneuver brigades are a significant piece of this evolving doctrine and architecture. As such, it is essential that a critical analysis of this doctrine and architecture be conducted now to determine if the intelligence community is heading down the right path.

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[1]Dennis J. Reimer (General USA), *Army Vision 2010* (Washington, DC: U.S. Headquarters, Department of the Army, 13 November 1996), 12.

[2]John W. Miller (LG USA), "Force XXI Vision for Change," *Military Review* 75, no 4 (May-June 1995), 1.

[3]Barbara G. Fast (COL, USA), "Building Situational Awareness In Force XXI." *Military Intelligence Professional Bulletin (MIPB)*, 23, no. 4 O(ctober-December 1997): 8.

[4]TRADOC, Briefing slide, "Force XXI," *Joint Venture* (Fort Monroe, VA: U.S. Army Training and Doctrine Command, October 1997) [Internet web site]; available from url: http://www/,pmrpe/ ar,u/,o;/pao.tradoc/sld006.htm. This web-site explains the Army's Force XXI hypothesis and objectives.

[5]The three listed "axes" to the Force XXI campaign plan are: the redesign of Army operational forces, the reinvention of the Institutional Army, and the development and acquisition of information-age technologies. The key component of these is the doctrine to institutionalize and "bring it all together." (Office of the Chief of Staff, Army, *America's Army of the 21st Century, Force XXI Meeting the 21st Century Challenge* (Fort Monroe, VA: Director, Louisiana Maneuvers Task Force, 15 January 1995), 11.

[6]The Strike Force with about 5,000 soldiers, will have the ability to deploy, almost immediately, a lethal modular force, tailored to operational requirements, and able to sustain itself and survive until mission completion or follow on forces arrive. The Strike Force is an Army concept, which is designed to fill a recognized void in capabilities available to the Commanders in Chief of the Unified Combatant Commands and the National Command Authority.

[7]The six patterns of Force XXI include project the force, protect the force, gain information dominance, shape the battlespace, set the conditions, decisive operations, and sustain and transition to future operations. The key pattern that impacts and demands the majority of INTEL XXI and current and future intelligence doctrine is "Gain Information Dominance" U.S. Army Training and Doctrine Command, Pam 525-75, *INTEL XXI*, (Final Draft Version) (Ft. Monroe, VA: Headquarters, U.S. Army TRADOC, 22 March 96), 1. From the author's opinion, the overall development of Information Dominance is key and central to the overall success of any success in future wars utilizing Force XXI doctrine.

[8]Claudia J. Kennedy (LG, USA), "Army Intelligence: Focussed on the Future," *Army,* 48, no. 10 (October 1998): 136.

[9]The leadership in the Army intelligence community began changing doctrine and architecture to correlate itself with current Army doctrine following Desert Storm. As stated by retired MG Stewart in a 1995 article in *Military Review*, "Over the last several years, the Army intelligence model has changed to reflect the new warfighting doctrine that will take us into the 21st century. In fact, based on modern warfare's changing nature, the intelligence community has been out front driving that change . . . why we have changed our intelligence paradigm and how those changes affect systems, organization and doctrine. The intelligence focus has changed." Robert L. Stewart, (Brigadier General, USA), "New Technology: Another Way to Get Oats to the Horses?" *Military Review* 45, no. 1 (January-February 1995): 31.

[10]Army Training and Doctrine Command, "Operational Architecture, Force XXI Armor/Mechanized Infantry Brigade" (Interm Draft) [CD ROM] (Fort Monroe VA: TRADOC, 6 February 1998), IV-5.

[11]IBOS is the equipment, procedures, and organizations designed for, and responding to, the tactical commanders with tactical, theater, and national intelligence products

[12]Several documents state that the CGS is currently fielded to maneuver brigades (as of November 1998). As of this date, a conditional fielding release from the Commanding General of OPTEC has authorized limited fielding to the XVIII Airborne Corps and III Corps pending final operational testing results continuing to be analyzed March of 1999.

[13]This new development of the MI DS support company at brigade level is typically referred to as the ACT concept or ACT. For the remainder of the thesis, the ACT term is a reference to this robust intelligence support element at maneuver brigade level.

[14]As of the date of publication of this thesis, the exact structure of the new DS MI company at the maneuver brigade varies based upon the type of maneuver brigade (light, heavy, air assault, or airborne) and remains dependent upon final revisions of doctrine being developed by the Intelligence Center and School.

[15]Although the Army has had variants of the CGS fielded since 1991, there have never been more than twelve different variants of the system fielded at any one time. These variants included an IGSM, LGSM, and a MGSM. The XVIII ABN Corps has been the only Army unit fielded with more than six. The others were fielded to the 513th MI BDE, III Corps, Korea and Germany. Therefore, adequate doctrine and TTP have never been developed for incorporation of a significant number of systems in a corps or support at brigade.

[16]In using the term developers, the author is referring to the product manager (PM), the TRADOC system manager (TSM), and the Intelligence Center and School.

[17]John F. Stewart Jr,. Brigadier General (retired), *Operation Desert Storm, The Military Intelligence Story: A View from the G-2, Third U.S. Army* (Riyadh, Saudi Arabia: Third United States Army, 27 April 1991), 31.

[18]The performance of the system during Desert Storm was critical for not only the future of the JSTARS, but for the ground station modules. There had been threats of canceling this system, having been developed specifically for fighting the Soviets in a European ground war scenario. The Air Force was able to use the success of the system during Desert Storm to justify the continuance of the program, which correlated with the Army's justifying the continued development and production of GSMs, leading to and including the CGS. Currently, 13 E-8C aircraft have been authorized by the 1997 quadrennial defense review. This was based upon recommendations by the Army as to what would be required to support the Army ground operations in the future. Current

doctrinal concepts envision three E-8C aircraft supporting each Army corps during any future (large) conflict.

[19]James P. Marshall (MAJ, USAF), *Near-Real-Time Intelligence on the Tactical Battlefield* (Maxwell Air Force Base, AL: Air University Press, 1994), 18.

[20]The Army as part of this joint program also has a seat on the two star and colonel steering committees, responsible for guiding and planning for the future of the program. One of the primary responsibilities is to determine the new capabilities to be incorporated based upon requirements from both the Army and the Air Force and to ensure that the air component and ground component remain compatible.

[21]The initial models of the GSMs (precursor to the CGS) were capable of downlinking with the OV-1D Mohawk and the newly developed JSTARS. The OV-1D (no longer in service) had the capability of providing MTI out to a 120 kilometer range.

[22]The view an operator sees (in the MTI mode) is the background map and a small yellow dot which depicts a moving target, such as a truck, tank, or other vehicle which is larger than approximately a car and moving at least six kilometers per hour. The operator also has the capability to view SAR images as the radar operator makes them available.

[23]Since the CGSs are in the process of being fielded to select units while this thesis is being developed, the author will refer to the Army down link as ground stations, a term which incorporates both the previously fielded GSMs and the CGSs.

[24]Ground stations located outside of line of site (LOS) can receive the radar imagery if the "master" CGS, located within LOS, rebroadcasts the data via SATCOM to the other CGSs located anywhere on the battlefield (theoretically), the world.

[25]Both the MGSM and the LGSM, as of late 1998, are still in the force inventory. These models will likely be cascaded to other units as the CGS models are fielded to priority units.

[26]The CGS is the final evolutionary step in the development of a ground station for the Army. Future modifications are planned to the system, with the next evolution intended to improve the imagery handling capability of the system and incorporate the capability of the system to receive and display improvements to the imagery (SAR) products received from the E-8C.

[27]While the system has been utilized by the military since Desert Storm, the fielding of the ground stations has been limited. Primarily, Korea, XVIII ABN Corps, and III Corps were the only units fielded with ground stations. Recently, the Army's contingency intelligence brigade (513th) was fielded with three MGSMs. Since fielding was limited, little emphasis has been placed in the development and implementation of

Army-wide doctrine or TTP for the various versions of the ground stations. The common result has been an ad hoc development of TTP when the system was deployed to Bosnia, Korea, or in support of different exercises. The most significant result being that each organization utilized the system differently, resulting in initially poor results from the system until the organization formalized a process to use the system.

[28]The focus is on the CGS and the supporting interfaces, doctrine, and architecture. While a significant amount of discussion has and will be made with reference to the JSTARS as a system, the development of the CGS has the Army developing, for the first time, a system that accomplishes several other functions besides being a ground station for the E-8C.

[29]The functions are listed in the *Heavy Force Digital TOC Narrative White Paper* which lists the functions which are to be accomplished by the brigade. This paper is available on the TRADOC internet home page.

[30]This conclusion is based upon a personal interview conducted with Dr. Harry Light, Director, Intelligence Directorate, Operational Evaluation Command, (conducted by telephone on 5 October 1998). His comments were that the GBCS had failed its initial operational test and evaluation conducted at Fort Huachuca mid-1998. (The official results have not been published or released.)

[31]A heavy and a light version are being built to support the different types of divisions.

[32]The interconnectivity with the Predator UAV was tested and proven during the JSTARS MOT&E conducted in 1996 in Bosnia, using the MGSM. Interconnectivity with the Hunter UAV was tested and proven during the CGS IOT&E conducted March and April 1998.

[33]Other intelligence systems such as ASAS, AFATDS and Trojan SPIRIT will be incorporated into the study as currently fielded with strict exception. The thesis will consider projected upgrades if they have been tested and proven. This will specifically apply to ASAS Block II that has undergone preliminary testing; proving that it provides improvements in interface, specifically an increase in imagery transfer, with the CGS. Other exceptions will be incorporated on a case-by-case basis.

[34]Headquarters, Training and Doctrine Command, TRADOC Pamphlet 525-5, *Force XXI Operations* (Fort Monroe, VA: TRADOC, 1 August 1994), 2.

[35]It goes without saying that U.S. collection systems will continue to improve their respective capabilities, thereby improving the quality or quantity of information provided to the CGS. While at the same time, potential future enemies will make improvements in their countermeasure capabilities (jamming, interdiction, etc.). But, the

overriding bottom line is that the overall future high-intensity battlefields of the future will not negate the capabilities of current and future U.S. collection systems.

[36]Headquarters, TRADOC, "4th Quarter 1999 Quarterly Update" (Accessed on the internet at url, http://www-tradoc.army.mil/updates/tqu.htm. [TRADOC publishes a quarterly update per quarter outlining the current status of various issues ranging from doctrine to systems]), 1.

[37]Headquarters Department of the Army, FM 100-6, *Information Operations* (Washington, DC: Department of Army, August 1996), 1. Currently, this term is being defined differently by different doctrine writers. According to the draft TRADOC PAM 525-69, Information Dominance refers to "a condition that results from the use of offensive and defensive information operations to build a comprehensive knowledge advantage at a time, place, and on decision issues critical to mission success. TRADOC Pam 525-69, *Concept for Information Operations* (Fort Monroe , VA: TRADOC, 1 August 1996), 2. This term is gradually replacing the previous concept of information superiority defined as "the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same." Chairman Joint Chief of Staff 9, DOD DIR 3600.1, *Information Warfare*, (Washington, DC: Department of Defense, 21 December 1992), 3.

[38]In some cases, when ASAS is not available, any system that receives the raw intelligence and receives and correlates the raw or processed information into useable intelligence is referred to as the processor. An example of this could be the CGS or the UAV GCS when a ASAS or an AFATDS is not present. In this case, the CGS or the UAV GCS would process the information into a product for the staff or the user. Therefore the CGS or UAV GCS could be referred to as the processor.

[39]While the listed doctrine on system employment remained in draft, the basics have been developed to the point that there was adequate material available to conduct the research. While minor changes can be expected, the author does not expect significant changes that will impact the results of the research.

[40]TRADOC Update, Fourth Quarter, 1. The TRADOC Update also states: "FM 100-5, *Operations*: The 1998 edition of FM 100-5 will be the fourteenth in a series that began in 1905 and it will be the second edition published since the end of the Cold War. The central theme of the manual is operational and educational rather than tactical and instructional. The revised final draft's purpose, structure, focus, and intended audience represent a significant departure from that of its predecessors. The scope and scale of global change since the end of the Cold War drive the requirement for this departure. The need is further reinforced by the necessity to adapt to continuing advances in technology and the requirement to respond to the needs of the nation in shaping the global environment. The anticipated publication date is 2nd quarter FY 99." (TRADOC Update, Fourth Quarter, 1.)

[41]The doctrine referred to includes the CGS TTP, FM 34-25-1, and all current TRADOC documents which reference the current development of Force XXI doctrine.

[42]Harry V. Phillips (MAJ, USA), "Does the Joint Surveillance Target Attack Radar System Support Military Peace Operations? A Case Study of Joint Surveillance Target Attack System support to Operation Joint Endeavor" (MMAS thesis, Command and General Staff College, Fort Leavenworth, KS, 1998), 115.

[43]The book *Lessons from Bosnia: The IFOR Experience* and the thesis prepared by MAJ Harry V. Phillips, both present an outstanding overview on the use of JSTARS in support of Bosnian operations. As stated in MAJ Phillips theses: "JSTARSs first deployed to support Operation Joint Endeavor from 14 December 1995 to 27 March 1996. A second deployment began on 1 November 1996 with end-of-mission scheduled for 31 December 1996. Hence, JSTARSs operated during the IFOR deployment and redeployment phases only. For both of the missions, the JSTARS E-8 aircraft operated from and was supported by crews at the Rhein-Main AB, Germany. . . . There were high expectations for its use in Bosnia but heavy terrain masking in mountainous Bosnia precluded optimal orbit tracks. Friendly forces were intertwined and intermingled among the FWF, and JSTARS could not distinguish friend from foe. JSTARS, designed to meet wartime requirements of detecting opposing force movements, was less useful in Operation Joint Endeavor. The JSTARS's SAR did identify some convoys and trench-lines but could not provide the necessary resolution for required recognition. It was best used to queue other assets, such as HUMINT and ground reconnaissance. A ferry site along the Sava River that was being used for moving military equipment in and out of Bosnia was identified as well as a railhead where armored vehicles were being loaded. Both of these success stories still required ground confirmation." Philips, 69.

[44]Headquarters, Training and Doctrine Command, TRADOC Pamphlet 525-69, *Concept for Information Operations* (Fort Monroe,VA: TRADOC, 1 August 1995), 25.

CHAPTER 2

INFORMATION RESOURCES USED IN THESIS DEVELOPMENT

> What is called "foreknowledge" cannot be elicited from spirits, nor from gods, nor by analogy with past events, nor from calculations. It must be obtained from men who know.[1]
>
> Sun Tzu, Fourth Century B.C.

A Multitude of Sources

The desire for more, faster, and more accurate intelligence is not new. Timely, fused, and accurate intelligence is increasingly becoming a cornerstone of not only Army military intelligence but of the entire military intelligence structure. Documentation on this topic varies significantly. With the advent of Force XXI, it appears that everyone is writing about the new doctrine and new equipment and are attempting to develop the story from several different perspectives.[2]

The availability of literature on JSTARS (the system) as a whole is extensive. Focusing specifically on the CGS, the literature is comparatively limited since the CGS has not been fielded to operational Army units.[3] This shortcoming is mitigated with personal knowledge and actual hands on use of the CGS, technical and operational test reports, and the after action reports (AARs) written about national training center (NTC) rotations, advanced warfighting experiments (AWEs), and other evaluation and test events, such as Roving Sands and the all-service combat identification evaluation test (ASCIET).

Sources utilized include the perspective from the acquisition community, users, and doctrine writers working Force XXI and Intel XXI specific issues. A challenge during the research was in understanding what actually took place during various tests or

exercises vice inflated results being promoted by the various organizations or agencies, specifically in the area of true and proven capabilities of the various systems. This factor was overcome to a degree by utilizing a multitude of sources to add balance to the information used in conducting the analysis.

Research uncovered a significant number of articles, briefings, and papers related to Force XXI and the new intelligence doctrine and thestructure being developed to support the new doctrine. While these articles provide a unique insight into the development and implementation of the doctrine, factual information from the proof of concept tests conducted as advanced warfighting experiments and other operational tests provided the essential sources of information related to the CGS and the supporting doctrine and architecture.

In regards to Force XXI and Intel XXI sources, TRADOC has produced a significant number of articles and pamphlets related to the development and implementation of the Force XXI doctrine. The base document, which has established the roadmap for this future, is TRADOC PAM 525-5, *Force XXI Operations*. Written in 1994, it states, "Force XXI will be the world's preeminent joint land fighting force, and the way it fights will define the nature of post-Industrial Age warfare."[4]

Numerous other pamphlets, articles, briefings, and documents clearly define the development, current status, and the future of this new doctrine. The author reviewed a significant amount of these while conducting research in support of this thesis. Because of the vast amount of material on this topic, the author utilized sources that had been validated by others or had been proven or used in the various tests, AWEs, or other exercises. Overall, all sources in regards to Force XXI stressed the criticality of adequate

intelligence support to provide information dominance, which is a key tenant of Force XXI.

The intelligence community has been aggressive in development of supporting doctrine to complement the evolving Force XXI doctrine. Modeled after an Army intelligence study conducted immediately following Desert Storm, which set the groundwork for intelligence doctrine and architecture during the 1990s, MG Claudia Kennedy directed that a second MI RELOOK be conducted to revalidate or revamp intelligence doctrine for the rapidly upcoming new millenium. In 1998, the Army intelligence community completed this significant intelligence study (*MI Relook*) which focused on the requirements for Army intelligence in the future. Currently being incorporated into Intel XXI concepts, it was and continues to be closely tied to supporting the current development of new Army doctrine and provided this study invaluable data as to where army intelligence is heading.[5]

Documentation from this process are available in a series of papers and articles released by the study. The overall results capture the complexity and unknowns of the future battlefield. Results also point out the complications present not only in todays Army, but the fact that the future wil only lead to further intensify the challenges for Army leaders. As stated by BG Wayne M. Hall (chief of the intelligence study) in his paper *Functions of Military Intelligence in 2010 Tactical Units*:

> Both battalion and brigade will operate within two chains of responsibility. One will be hierarchical and will provide somewhat traditional chain of command leadership. This chain will be different from what we currently experience owing to technology providing access to better information more quickly, powerful visualization tools, and for collecting information pertinent to problems at hand.

> The second chain of influence will be the chain of information. This chain won't be hierarchical. I can best describe this phenomenon as the flow of information through channels that resemble a tangle of fish line--connections and relationships abounding, but distinctness by way of clear lines and hierarchical relationships nonexistent. In this chain of information nobody will impede sharing and flowing of information--its the way of the digital age and we must learn to capitalize on its inherently nonlinear, chaotic energy.[6]

This provides a glimpse into the complexity operators can expect to see as the first fully digitized units are formed.

The Army's Field Manual (FM) 34-25-1, *Joint Surveillance Target Attack Radar System,* is the currently published doctrine addressing the employment of the previous versions of the CGS. While many aspects remain valid, this FM is dated, with the capabilities of both the E-8C and the CGS outdating this FM in several areas. In order to develop a study that deals with the relevant issues, the current TTP under draft by the TSM CGS is utilized in conjunction with the existing FM 34-25-1. The TTP deals with all operational aspects of the CGS, incorporation of interface systems, and use of the system at brigade level.

Key in the new CGS TTP document is the architecture of the system in relation to the collection systems, processors, and preprocessors it interfaces with. The CGS TTP also depicts how the system is to be used at each echelon, in conducting the different functions of the system (surveillance, targeting, and battle management). The TTP and FM 34-25-1 provide the foundation against which the analysis of this doctrine and architecture is utilized to answer the primary thesis question.[7]

Test reports prepared by the operational test and evaluation command (OPTEC), the Army's independent test organization, provides a unique and unbiased look at the technical and operational capabilities of the system. These reports include all aspects of

the development of the CGS, from the initial technical tests conducted at the Motorola facility (where the system is built) to the most recent operational test conducted during the summer of 1998.[8] The reports collated into one inclusive "CGS System Analysis Report" provides extensive insight into the technical capabilities, operational capabilities, and overall sustainability of the system as tested with actual soldiers operating the CGS.[9] The most critical portions of the report include information from the operational test which had soldiers from the XVIII ABN Corps operating the system in an operational setting with all links connected and functioning, while conducting an operationally realistic mission.

Other sources of information providing information critical to understanding the joint issues with the system came from both OPTEC and the Air Force Operational Test and Evaluation Command (AFOTEC). Each organization has conducted extensive independent and joint testing of both the E-8C aircraft and the various versions of the Ground Station.[10] Both OPTEC and AFOTEC have documented results from these deployments and operational tests of the E-8C, ground stations, and the overall system in numerous reports. The primary reports, critical in understanidng the development of the system, are the *Operational Test Report from Desert Storm* and the *System Evaluation Report--MOT&E;* also referred to as the *Operation Joint Endeavor Report.*[11]

The *Operational Assessment of the Joint Surveillance Target Attack Radar System Common Ground Station* (7 October 1998) report prepared by the office of the director of operational test and evaluation (DOT&E) states that not only the CGS, but that the entire JSTARS system continues to have significant problems. The report, signed by Mr. Philip E. Coyle (Director, DOT&E) states:

> I have completed my assessment of the JSTARS CGS. The JSTARS CGS as tested in the IOT&E was not operationally effective and not operationally suitable in the accomplishment of the surveillance and target attack missions. This was due collectively to a low rate of target detection, large errors in location of targets that were detected, inability of provide adequate support for SCUD hunt missions, an inability to effectively use all sensor inputs to the CGS, a CGS design that is not user friendly, low reliability and availability of the CGS deficiencies in the E-8C radar, and inadequate tactics, techniques, procedures, and operator and joint training. The IOT&E also provided insights into potential modifications that can be implemented to more effectively utilize JSTARS technology in the future.[12]

Other reports, which provide more insight into the operational use of the system, come from operational system testing conducted during several theater, corps, division, and brigade level exercises during which various versions of the ground stations provided support. These operational assessments are unique in the fact that the testers are simply observers of the operational use of the system during the exercise. Test and evaluation teams observing the exercise have no impact upon the operations or on how the system is utilized. Therefore, this provides a unique look into how a unit actually incorporates the system both from the doctrinal aspect and in the architectural connectivity realm. OPTEC has produced operational assessments for exercises: Purple Dragon, Roving Sands, and ASCIET (all conducted in the 1997-1998 timeframe).

The Army's Center for Army Lessons Learned (CALL), TRADOC, and OPTEC have produced several excellent reports from the different AWEs detailing the effectiveness of CGS TTP when utilized in conjunction with the Army's Force XXI and the new intelligence doctrine. These same agencies also produced several documents related to intelligence support during various AWEs and NTC rotations when the CGS and the ACT were utilized in concert.[13] AAR's from NTC rotations and AWE's

provided unique input from the users perspective as to the value added and problems encountered with the system or structure.

Reports produced by TRADOC and CALL also provide insight into the use of the CGS, TF XXI concepts, and supporting intelligence doctrine during the conduct of the force development tests and experiments. The CALL documents *Initial Impressions Report* (AWE) and Command, Control, Communications and Intelligence (C3I) at the Advanced Warfighting Experiment (AWE) and several other recent CALL articles describe the use of new systems to include the CGS and the new ACT concept in support of brigade operations. The reports document both successes and failures and provide the rational for recommended changes in both architecture and doctrine. Overall, the reports indicate that the brigade staffs were satisfied with the information provided by the CGS, specifically the JSTARS imagery that provided battlefield visualization, allowing the staff to react to perceived near real time (NRT) movement by the opposing forces.[14]

While the above-listed AWE and operational test reports are the cornerstone for the analysis conducted in this thesis, there were often differing views presented in the different reports. Reports produced by CALL and TRADOC are generally very favorable of the system, while OPTEC's and DOT&E's reports are much more critical. The specific test settings utilized during the operational tests vs. the AWE events likely causes this dichotomy. The AWE was conducted primarily in a desert environment with a relatively large opposing force. It was relatively easy for the CGS to provide the information required to the supported staff because of the small collection area and unobstructed view provided by a relatively clear desert battlefield. While in the majority of operational tests and assessments conducted by OPTEC, the area of coverage was

often much larger, in wooded and rolling terrain with several agencies utilizing the E-8C, causing the focus of the system to be directed against several different areas at the same time.[15]

Specific information concerning other interfaces that provide intelligence to the CGS is available in a series of reports produced by OPTEC and the Intelligence Center and School. Test reports on the Trojan SPIRIT, UAV, and ASAS are available in additional system evaluation reports produced on each of these systems. These documents provide architectural and doctrinal issues from the perspective of the other systems in their interaction with the CGS. These documents highlighted several operational utilization issues which are essential in the development of issues related to the existing architecture and doctrine for the CGS.[16]

In order to understand the technical capabilities of the CGS, numerous sources from both the Army and the Air Force which outline the technical operational capabilities of both the E-8C, CGS, and other interfaces were utilized. These include the Army's CGS technical manual, 1998 version, and the Air Force's technical manual, E-8C "Aircraft Mission Console Operations," 1998 draft version. Both sets of manuals were used to understand the full spectrum of capabilities available in the E-8C, the CGS, and the overall system as a whole. To a lesser degree, technical manuals related to the various interface systems were utilized in order to understand the interface goals intended between that system and the CGS.

Although JSTARS is a joint system (program), there is not an agreed upon joint doctrine for the overall system. Agreements between the Army and the Air Force have been established through a maze of different memos and verbal agreements made during

various colonel and general officer reviews. This being the case, a document referred to as the *JSTARS Contingency Operations* (which is classified as secret and also referred to as the concept of operations (CONOPS)), produced in 1996, has been utilized as the existing agreement between the two services in the utilization of the system. This document details the basic operating procedures for the Army in tasking and utilizing the E-8C to support CGSs.[17] The CONOPS, in summary, details that JSTARS will

> provide the surveillance, target detection, and tracking required to develop an understanding of the enemy situation and to contribute to plans to delay, disrupt, and destroy the offensive and defensive momentum of enemy forces based on the JFC overall objectives, JFLCC scheme of maneuver, and the JFACC air campaign guidance. The primary mission tasking is to ensure "dedicated support" of the ground commander's requirements through a jointly manned JSTARS E-8C platform. The air commander will be supported simultaneously by the joint mission crew.[18]

Two other joint documents which reference JSTARS and the CGS (concerning the joint intelligence provided to the CGS) are Joint Publication 3-55, *Doctrine for Reconnaissance, Surveillance, and Target acquisition Support for Joint Operations,* 14 April 1993, and Joint Publication 2-01, *Joint Intelligence Support to Military Operations*, 20 November 1996.

Several briefings produced by the PM, TSM, Motorola, Northup Grumman, and OPTEC were beneficial in diagramming links, interfaces, and in providing the graphics utilized throughout this thesis. Articles from commercial publications and professional journals such as *Aviation Week and Space Technology*, *Military and Aerospace Electronics*, *Military Review*, *Military Intelligence Magazine*, and *Army Communicator* were considered as additional sources for this thesis and provided valuable input, providing differing objective viewpoints. Of significance, the *Military Intelligence Professional Bulletin* provided significant information covering all aspects of this thesis

to include, doctrine, information on intelligence systems, and results of various tests or experiments. Of note; not all articles were complimentary of the evolving doctrine. Some articles, such as the article by Colonel Barbara G. Fast, "Building Situational Awareness in Force XXI," were critical of the developing intelligence doctrine and made several alternative recommendations concerning the current military structure at echelons division and below.[19] This is contrasted with an article by MG William S. Wallace and LTC William J. Tait when they state that "the Army's intelligence doctrine, and indeed most Army doctrine in general, was proven sound by the experiment [Reference the 4ID(M) Division Advanced Warfighting Experiment conducted November 1997]."[20]

As the Army scrambles towards new doctrine and systems designed to keep it as the world's premier land force, it is essential that analysis is based on current as well as the hard learned lessons from the past. This is valid because of the fact that the intelligence components (directing, collecting, processing, and disseminating) have not changed dramatically since World War II. As stated by BG Oscar W. Koch, "Even as new intelligence techniques and practices were found and improved upon, the basic processes remained the same [reference the intelligence components]."[21] Therefore several historical documents to include: *The Military Intelligence Story (Desert Storm)*, *Conduct of the Persian Gulf Conflict*, and several older *Military Review* articles were researched to ensure that the new doctrine and architecture were indeed incorporating previous lessons learned.

From the historical perspective, the intelligence community appears to be incorporating the majority of lessons learned (most significantly from Desert Storm). Some of the central complaints from Desert Storm included a requirement for increased

imagery dissemination architecture and increased intelligence support at brigades. New intelligence architecture and doctrine are being developed to alleviate both of these concerns, notably with the fielding of the CGS, with its capability to receive and process secondary imagery products.

The sources available provide a wide range of information. In total, they provide adequate background and current insight into the use of the CGS supporting a maneuver brigade. A challenge with the sources available is the fact that many of the documents utilized discuss results of testing, which does not always provide a true picture of operations one would see in an actual operational or non-test environment. Utilizing all available sources in order to provide balance and accuracy mitigates this issue.

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[1]Sun Tzu, ed. and trans. Ralph D. Sawyer and Mei-chun Lee Sawyer, *The Art of War* (New York: Barnes & Noble Books, 1994), 67.

[2]Because of the era of constraining budgets and continuing cuts, each branch, various contractors, and different special interests groups are promoting their project, program,or system. This is primarily because with a smaller budget and a smaller force, all branches, services, and program offices are scrambling for funding. By getting their specific story out first, it may improve their chances of success.

[3]While there is a trove of literature reference testing, the development, and the concept of the CGS, there is almost no literature written (as of yet) which conducts an analysis of the value or added benefit of this system. In that regards, this thesis will be one of the first critical documents conducting an analysis of this system.

[4]Headquarters, Training and Doctrine Command, Pamphlet 525-5, *Force XXI Operations* (Fort Monroe, VA: 1 TRADOC, August, 1994), 3-3.

[5]Products from this study can be found on the ODCSINT Creative Ideas Bulletin Home Page http://www.inscom.army.smil/mil/odcsint/creative_ideas/voltage/ 27sep98.html. Last accessed on 10 March, 1999.

[6]Wayne M. Hall, BG USA), "Functions of Military Intelligence in 2010 Tactical Units" (27 September 1998, located on the ODCSINT creative ideas bulleting home page http://www.inscom.army.smil/mil/odcsint/creative_ideas/voltage/ 27sep98.html), 2-3.

[7]FM 34-25-1 remains in use while the current TTP specific to the CGS remains in draft form and has not been submitted for final signature or approval.

[8]A follow-on test of the CGS was conducted by OPTEC in early February 1999. The purpose of this test were to determine if the PM and Contractor have repaired significant errors uncovered during the IOT&E conducted in March-May 1998. Information from these tests proved only that the operational availability of the CGS has been improved as compared to the initial IOT&E.

[9]The *Common Ground Station System Evaluation Report* is currently in draft, pending the results of additional testing conducted in February 1999 to be incorporated. The author utilized the draft report which he considered as valid because the testing done in February was more of a technical test and was not conducted in the mode of an operational test.

[10]On occasion, OPTEC and AFOTEC did conduct joint tests, producing consolidated reports on the overall capabilities of the system. Most significant of these was the MOTE conducted in Bosnia, Germany, and Italy in 1996.

[11]When the JSTARS system with supporting GSMs were deployed to Bosnia in 1995/96, it was decided to conducted the operational test of the system during the deployment. This cancelled a multi-million dollar MOT&E that was to be conducted late in 1995 at Fort Huachuca and several other posts.

[12]Philip E. Coyle, *Operational Assessment of the Joint Surveillance Target Attack Radar System Common Ground Station* (Washington, DC: DOT&E, 7 October 1998), 1.

[13]In some cases, a prototype CGS was used during the experiments. The overall capabilities in the CGS (P) are considered as equivalent to the current CGS under discussion.

[14]Center for Army Lessons , "Learned Rapid Force Projection Initiative" (coordinating draft), (Fort Leavenworth, KS: CALL, 25 April 1999), 3-12.

[15]While this caused some difficulty in conducting the analysis of data, understanding the test environment and the goals of each event, assisted in the deconflict. Overall comments reference the architectural implementation of the CGS are in agreement, while recommended changes in doctrine conflict.

[16]Primary issues were in dealing with how the brigade S2 conducts collection management of the system (how he requests products to be sent to the CGS).

[17]The JSTARS CONOPS provides the basic tasking procedures the army will use in requesting E-8C support, and the architecture to be employed during contingency

operations. It primarily deals with the process of the higher echelons process of requesting and tasking the E-8C in conjunction with the Air Force.

[18] Department of the Air Force, *Joint STARS Concept of Operations* (Washington DC: SAF/AQPC, 29 October 1994), 2.

[19]Barbara G. Fast (LTC, USA), "Building Situational Awareness in Force XXI." *Military Intelligence Professional Bulletin* (MIPB), October-December 1997), 8-14.

[20]William S. Wallace (MG USA) and William J. Tait (LTC USA) article: "Intelligencein the Division AWE: A Winner for the Next Millennium" *Military Intelligence Professional Bulletin* (MIPB), (April-June 1998), 7.

[21]Oscar W. Koch (BG USA retired) and Robert Hayes, *G-2: Intelligence For Patton* (Philadelphia, PA: Whitmore Publishing Company, 1971), 133.

CHAPTER 3

DEFINING THE SYSTEM AND THE INTERNAL AND EXTERNAL IMPACTS

> We are designing the systems, interfaces and procedures necessary to bring in external support tailored to an organization's needs.[1]
>
> LT GEN Claudia J. Kennedy

New Doctrine, New Army, New Times

Many in the intelligence community point to the CGS as the centerpiece intelligence system, which provides almost all intelligence required by the commander and staffs at any echelon of the battlefield.[2] During Desert Storm JSTARS with the supporting ground stations provided the conclusive intelligence upon which the 3rd US Army Commander based almost all operational movement of Army ground forces.[3] Several years later, the Army is still in the process of determining how, were, and when to incorporate the CGS in order to provide the best intelligence where and when needed.

In order to conduct an analysis of the proposed CGS architecture and doctrine, it is necessary to understand several background and current factors which impacted the development of the CGS architecture and doctrine. Some of these include the basics of the Force XXI doctrine which the CGS will support, the overall structure and mission of the maneuver brigade, and the proposed CGS TTP. These items are discussed in order to provide the reader a baseline understanding of the current doctrine and architecture, impacts on the CGS, and the overall capability the CGS brings to the maneuver brigade. This then will facilitate the understanding and the rational for the research model design, and the follow-on analysis conducted in the subsequent chapters.

The Future Threat

As stated in TRADOC PAM 525-5, the future battlefield will range from high-intensity warfare to peacekeeping operations. According to TRADOC reference future wars, "battle between mechanized forces [in the future] will be similar to armored operations of the past three decades."[4] Complementing this statement, the *Threat White Paper* produced in support of the 1998 Intel XXI Study states that there will be "no major short-term changes in mid and high-intensity conflict . . . the net effect will freeze many aspects of middle and high-intensity conflict in their current, industrial-age norm."[5] Therefore, the Army can expect that future high-intensity warfare will be fought with mechanized and armor forces. This provides the rationale that collection systems as designed are capable of collecting against these types of forces as proven during recent conflicts and that the current collection systems which support the CGS will be effective in the near term future. (This of course does not take into account countermeasures that will likely be designed to counter US efforts.)

Intel XXI and Force XXI

To support the tenants of Force XXI and to prepare for the projected future threat, the intelligence community has developed a parallel process with the intention of developing concurrent doctrine to support Force XXI concepts. The overall concept of Intel XXI, as stated in the *Army Science and Technology Master Plan* (*ASTMP*):

> Intelligence (Intel) XXI is the Army intelligence vision supporting Force XXI, created to provide intelligence support to Army Warfighters at all echelons, joint and ground component commanders, and coalition forces across the continuum of 21st century military operations. This vision provides commanders with a knowledge–based, prediction–oriented, and operationally flexible intelligence system. Intel XXI is focused on intelligence support for the force projection Army in the information age of the 21st century.

> The focus of Intel XXI is on the presentation of intelligence in a way that immediately conveys an understanding of the battlespace and the significance of the intelligence presented. Underlying the focus on presentation is an operationally flexible system executing an expanded intelligence cycle (present, manage, collect, process, and disseminate) in a more rapid and focused way to provide the commander what is needed, when it is needed, melded with his operational plan. The essence of intelligence is the ability to reduce uncertainty and provide an understanding of the battlefield through effective presentation. Intel XXI will enable us to leverage information age technology to do exactly that.[6]

As stated in this excellent summary from the ASTMP paper, the key components of Intel XXI are focussed on the dissemination and presentation of information and intelligence. The intention is to provide the visualization of the battlefield required by commanders in the execution of any mission. It is based upon the intelligence process of directing, collecting, processing, production, and dissemination, with emphasis placed on the importance of presenting the information quickly and in the most efficient manner possible. The goal is to allow the commander to quickly view and understand the intelligence in order to be capable of enhanced situational awareness.[7]

Force XXI concepts reference intelligence operations and capabilities necessitate improvements in the brigade commander's ability to visualize the battlefield, to rapidly maneuver, and to bring fires with accuracy and timeliness to effect the outcome of the battle. Advances in technology have evolved to the point that the brigade can now execute these capabilities. The doctrine and the many tools to support this involves the implementation and integration of both Force XXI and Intel XXI inclusive with the fielding of the CGS at the brigade. These new changes are being promoted by TRADOC as providing a significant improvement that will provide the brigade the capability "to see

the entire battlefield in depth, identify key targets and attack with a wide choice of joint, as well as Army systems, whenever and wherever the commander desires."[8]

To support these aggressive goals, the Army is involved in a digitization effort to speed and enhance the collection and dissemination of all types of information. The concept is adequately stated in TRADOC PAM 525-5:

> Advanced Army and joint intelligence systems that feed into ABCS will enable commanders to detect and track enemy forces throughout a given battlespace. This capability presents new challenges because information about enemy posture, position, and activity will be known earlier and in far greater detail than ever before. For example, before the ultimate intent of an enemy force can be determined, the benefits versus the risks of early attack with limited inventories of long-range precision weapons must be carefully analyzed.[9]

Force XXI is based upon the fact that "information age technology will provide commanders a comprehensive view of the situation, reduce uncertainty and provide the means to more clearly and rapidly transmit information, intent and orders."[10] Intel XXI is the concept being pursued in order to deliver the technology and a process by which to satisfy the requirements levied by Force XXI. The central and critical feature of both Force XXI and Intel XXI will be the ability to collect and exploit information quickly to attain synergism among systems and organizations.

Implementation of Intel XXI and Force XXI doctrinal concepts and architecture at the brigade echelon to include CGS operations will have a profound impact on both the operations of the CGS and the maneuver brigade. To support the tenants of the developing doctrine, the intelligence assets provided by the Direct Support Intelligence Company will more than triple the size of the previous intelligence analytical support structure. The end result being that the brigade will receive a significant increase in both

raw and processed intelligence as compared to intelligence received prior to the implementation of this new concept.

In summary, Force XXI and Intel XXI are extremely dependent upon technological advances in systems and processes.[11] An obvious Achilles heel is an over-dependence upon the technological advances and possibly inadequacies of the developing doctrine. Many in the intelligence community point out that the CGS, in its ability to display the products of several different intelligence collection systems and to display real time intelligence from the E-8C, as the ultimate answer to providing the required information dominance.[12] The corresponding CGS doctrine and architecture therefore are designed to "push" raw intelligence into the brigade staff at several different points.

The overall impact that Force XXI and Intel XXI upon the CGS has resulted in a system designed to interface with numerous collection systems and to provide the resulting information to numerous users. The design concept is based upon an "open architecture" which allows for the relatively easy inclusion of new interfaces or enhanced technologies. The overall mission of the CGS best captures the impact of Force XXI and Intel XXI. As stated in the CGS TTP, the CGS

> supporting the Commander has three critical and complementary components: (1) to provide the commander a near real time (NRT) picture of the "Now Battlefield" (based on available sensor feeds, each CGS has the capability to provide the supported commander a common picture of the battle space); (2) contributes to the intelligence process by providing multi-sensor information to the All Source Analysis System (ASAS) and other intelligence processors; and (3) provides the foundation for CGS support to the commander's targeting process. The CGS capability to detect, track, and locate vehicular movement is key to the commander's ability to interdict and destroy enemy formations throughout the battle space.[13]

The CGS, from the perspective of the intelligence community is custom made for immediate incorporation into the constructs of Force XXI and Intel XXI at the brigade

echelon. With its ability to provide multisource and near real-time intelligence to different staff elements at the tactical echelon (brigade), it provides an incredible increase in available intelligence (both raw and processed) to the various users at the brigade.

One additional impact that Force XXI has upon the CGS can best be summed up in one word, "expectations." During the author's year at CGSC in 1998-1999, JSTARS and the CGS were constantly stated as being the key intelligence system(s) which will provide the commander with information dominance and real time situational awareness. Various articles and briefings also attested to the significance of these systems. At various tests and AWEs utilizing simulated and live E-8C data feeds into the CGS, the users came to expect that the CGS would provide the necessary intelligence allowing the commander to accurately focus assets and defeat the enemy. The end result being that as the CGS is fielded, it had better deliver as advertised.

Brigade Organization and Structure

> The advanced digital communications and information sharing technologies found within the digitized brigade are used to enhance the brigade's situational awareness. Emerging Force XXI initiatives when coupled with existing automated systems provide a new warfighting facet to commanders at both tactical and operational levels. These advanced digital systems will have a significant impact on the doctrinal employment of the brigade and the tactics used by the brigade while operating in a digitized environment.[14]

The Force XXI brigade is designed to operate in the entire range of combat operations. No matter what type of brigade (heavy or light), the guiding principle is that smaller more powerful brigades will utilize "firepower, maneuver, and information dominance to destroy the enemy".[15] This concept emphasizes the fact that the organization of the brigade is fluid, can be task organized to meet the specific mission, will be smaller and more lethal, and will be extremely dependent upon information

dominance to defeat any threat. Planners are counting on enhanced collection and intelligence processing at the brigade level and the digitized command and control systems to enhance the unity of effort and enhance combat power effects.[16]

The overall structure of the brigade retains the standard S2 staff consisting of the S2 and the supporting intelligence staff element. The S2 is the primary staff officer for intelligence and supervises the overall tasking and production of the Direct Support Military Intelligence (DS MI) Company. The S2 is the central point in developing the intelligence requirements required to meet the operational objectives of the commander. In conducting the traditional IPB process, the S2 oversees the integration and analysis of data provided by the DS MI Company and integrates this information with the tactical combat information from the lower tactical combat elements in order to develop and portray to the commander an accurate picture of the enemy situation.[17] The actual entry point of CGS information into the S2 section is through the analytical control team (ACT). The ACT can share CGS provided information as correlated or raw intelligence products via the ASAS, hardcopy products, or by face-to-face coordination.[18] As can easily be seen, the complexity of the S2's responsibility has increased significantly. (With the addition of the CGS, UAV, and the Trojan SPIRIT at the brigade, the S2 has the increased role as a collection manager.)

The second section of the staff is the S3 staff element. This element coordinates the maneuver aspects of brigade operations. The S3 section monitors the situation in terms of the brigades capability and disposition in relation to terrain, mission objectives, and the enemy situation. It will do this (based upon current doctrine) by observing the E-8C data, UAV, or other intelligence product displayed upon various display screens. This

provides a method by which the maneuver staff can coordinate with lower maneuver elements, fire support, attack aviation, or Air Force elements as they direct the defense or the attack. The S3 section receives CGS information directly from the master screen or the CGS remote work station (RWS) and in a processed form via the maneuver control system (MCS).

The third section of the brigade staff which will have significant interaction with the CGS is the brigade fire support officer (FSO) and the FSO section. In conjunction with the fire support coordinator (FSCOORD, the FSO section assists the commander in determining where, when, and at what point or targets fires should be applied. The FSO element via the sharing of situational awareness, is linked digitally by AFATDS with the firing batteries and laterally and horizontally with other fire support commands in the field. The AFATDS, as part of the ATCS network, obtains and provides updates and receives a direct feed of target locations from the CGS.

The overall result of the new maneuver brigade concept is that the CGS and additional intelligence assets have been provided to the brigade in order to support the new concept. The impact that the brigade structure has on the CGS in relation to the tenants of Force XXI has resulted in a CGS design that provides intelligence directly to the various staff elements. Previously, all intelligence passed through the S2 who then disseminated the intelligence to other staff elements as required. The CGS with its wide range of collection inputs provides the intelligence required for the brigade to operate more independently, without being tied to the single-thread intelligence flow traditionally seen in the past.

The Digitization Effort

> Advances in technology are continually changing the way warfare is conducted at a pace now greater than ever before. Micro-processing, miniaturization, communications, and space technologies have combined to permit almost real-time intelligence and information sharing, distributed decision making, and rapid execution of orders from a wide variety of forces and systems for concentrated effect.[19]

To support staffs and commanders utilizing the tenants of Force XXI, the brigade has been augmented with automated systems to assist in the when, where, why, and how of military operations and in the control of the tempo and synchronization of battles. The army battle command system (ABCS) provides commanders specific knowledge of mission, enemy, troops, terrain, and time available (METT-T). The goal is a rapid and precise vision of the battlefield, resulting in dominance in battlespace and control of the tempo of operations.

In its simplest constructs, the army battle command system (ABCS) is the architecture and multi-BOS systems that provide digitized command and control support to the brigade staff and commander. The concept is to provide the commanders and staff at the tactical echelons (both laterally and vertically) with situational awareness, a common operating picture, logistics management, and the ability to send and receive digitized orders and graphics. Components of this system relevant to brigade operations include the Force XXI battle command brigade and below (GC2B2) located at brigade and lower echelon operations centers and the five army tactical command and control systems (ATTCS) which are associated with separate battlefield operatings Systems. ATTCS is composed of the MCS, ASAS, AFATDS, FAADC2, CSSCS, and the FBCB2.

1. Maneuver Control System (MCS) supports the maneuver BOS by supporting cross-staff and multiechelon planning through integration of information. The CGS has secondary input to MCS via ASAS.

2. All-Source Analysis System (ASAS) is a production system supporting the intelligence BOS by processing, fusing, analyzing, and disseminating enemy information for decision making which may include precision targeting and threat development. The CGS has primary input via sharing of standard message formats.[20]

3. Advanced Field Artillery Tactical Data System (AFATDS) supports the fire support BOS by providing information on targets, location of friendly and threat indirect fire assets, and fire support coordination measures. CGS has primary input via sharing of standard message formats.

4. Forward Area Air Defense Artillery Command and Control System (FAADC2) supports the air defense BOS by providing a air picture with information on friendly and threat aircraft with links to echelons above brigade nodes. CGS has no input or links with the FAADC2.

5. Combat Service Support Control System (CSSCS) supports the logistics BOS and provides interface between ABCS and all logistics management information systems. CGS has no input.

6. Force XXI Battle Command Brigade and Below (FBCB2) is a digital battle command information system that provides on-the-move, real-time and near-real-time battle command information to tactical combat, combat support, and combat service support leaders and soldiers. FBCB2 supports situational awareness down to the soldier or platform level across all BFAs and echelons and forms the principal digital command

and control system for the Army at brigade and below. FBCB2 also provides the means for brigade and battalion commanders to command when away from their TOCs and when interoperating with subordinate commanders and leaders using FBCB2.

The significance of the digitized components of ABCS is self-evident. Information from the CGS can be moved not only through the intelligence system channels electronically, but this same information can also be disseminated either directly or indirectly with the other BOS systems. The overall speed, of not only information being passed but of subsequent taskings flowing throughout the intelligence system, is increased dramatically. The impact of this will become evident in chapter 4 and 5 during discussion of the intelligence system within the brigade..

Intelligence Support to the Brigade

> Confronted with a task, and having less Information available than is needed to perform that Task, an Organization may react in either of two Ways. One is to increase its Information-Processing capacity, the other to design the Organization, and indeed the Task itself, in such a way as to enable it to operate on the basis of Less Information. These approaches are exhaustive; no others are conceivable. A failure to adopt one or the other will Automatically result in a Drop in the level of Performance. Lacking the wherewithal to effect all-automated operations, Commanders must construct their Organizations and Operations so the need for Extensive Information is not necessary, only Minimum, Vital Information being Necessary.[21]

To support this concept, the intelligence community has developed an enhanced lower echelon intelligence capability to include collection assets, preprocessors, processors, and additional production personnel to support this digitized brigade concept. The CGS, in fitting into this new structure at brigade, is expected to enhance several portions of this new concept to include increased surveillance support for the S2,

enhanced targeting capability for the FSCOORD and ALO elements, and battle management support for current and future operations (S3).

To adequately understand the CGS in its relationship to doctrinal and architectural support at the brigade, one must understand the intelligence structure now existing at the brigade echelon. As previously discussed, the CGS provides information to different staff elements of the brigade. The primary element with which the CGS interfaces with is the brigade's supporting DS MI company's ACT element.

For normal tactical operations, the division MI battalion deploys a DS company to each ground maneuver brigade. This MI DS company supporting the ground maneuver brigade has an ACT and an operations platoon. The ACT develops the battlefield picture in support of the brigade S2 section and provides targets to the FSE. The ACT also includes operators and equipment to receive sensor data from the UAV, JSTARS, Guardrail common sensor, Apache Longbow, and the general support company electronic intelligence collection systems.[22] The operations platoon consists of a UAV team, a counterintelligence team, and an interrogation team.

The maneuver brigades have historically been supported with this DS MI CO.[23] The overall mission of this company is to provide direct intelligence support to the maneuver brigade. The new DS MI CO structure enhances the previous structure of support to the maneuver brigade by enhancing the analysis and processing capability of this intelligence company with the addition of the ACT. The DS MI CO also provides additional intelligence assets and brings a substantial increase in both raw and processed intelligence and information into the brigade.

Improvements in several different intelligence systems provide technological advantages enhancing the DS MI CO's support to the brigade which makes the potential support to Force XXI concepts possible. The ASAS remote workstation supports collateral intelligence processing at maneuver echelons at the brigade.[24] The UAV provides near real-time intelligence, target acquisition, battlefield damage assessment, reconnaissance, and surveillance. The CGS brings the inherent capabilities that include near real-time moving target indicators, synthetic aperture radar, and receipt of UAV, IMAGERY and UAV video. These systems dramatically increase the overall intelligence capability at the brigade echelon.

The ACT normally collocates with the company CP at the brigade TOC. Unlike the analytical control element (ACE) at higher echelons, the ACT is not normally under operational control of the brigade S2. Under the direction of the DS MI company commander the ACT provides the brigade S2 automated intelligence processing, analysis, and dissemination capabilities. In addition, the MI company commander uses the ACT to support asset management and reporting of subordinate counter intelligence (CI), human intelligence (HUMINT), and imagery teams. The ACT uses its ASAS workstation to access databases, reports, graphics, and other products from higher echelon organizations, primarily the division's ACE. When augmented with the Trojan SPIRIT, the ACT can conduct split-based operations, pulling support and information from an intelligence support base outside the area of operations (AO).

In summary, the ACT is the DS MI company hub of support for each of the maneuver brigades of the division. It provides the brigade with a significant increase in intelligence connectivity, fusion, analysis, and the ability to maintain a integrated

(horizontal and diagonal) intelligence database. The ACT provides the brigade S2 with automated intelligence processing, analysis and dissemination capabilities and feeds from higher echelons via digital links to provide intelligence data from national, theater, corps, and division collection and analysis systems.

The central aspect of the ACT is in providing additional analytical and collection support for the ground maneuver brigade S2 section. The incorporation of the ACT is essentially a mini ACE now located at the brigade level. The ACT brings together the ground station operators and the analysts within the brigade S2 section. The ground station operators provide sensor data from GBCS, guardrail common sensor, airborne quick fix (AQF), Apache Longbow, JSTARS, and other collection sources. Combining and coordinating the analytic efforts of the ACT with the analytic efforts of the brigade S2 section, a substantially enhanced picture of the battlefield is provided to the commander and the staff, with a substantial increase in processed intelligence disseminated to the maneuver battalions.

While collection of intelligence (technical means) is a significant part of the overall intelligence system, the means or process of analyzing and presentation (or display) of this information to commanders and staffs is critical. The large amount of intelligence that the brigade staff receives has the potential to overwhelm the intelligence staff element, including the ACT, and result in displaying the massive amounts of raw intelligence directly to the commander or staff. This may overwhelm all elements within the brigade staff. In this case the staff would likely act upon the most significant raw intelligence shown, without incorporating all intelligence needed to gain a picture of the

entire battlefield and without understanding the enemy situation with which they are confronted.

The impact this new intelligence support has upon the CGS is yet to be determined. Because of the fact that the CGS provides a significant increase in information to the brigade, the inclusion of the ACT makes sense since it has the dedicated capability to task and receive this information. Without this structure, it is doubtful that the previous lean S2 section would have been capable of handling and controlling this increase of available information.

CGS

> The CGS was conceived and built to correct information dissemination problems discovered during the Gulf War.[25]

As described in chapter 1, the CGS is the follow-on to the Ground Station Module (GSM). The current CGS configuration provides sensor data, analytical tools, and technology upgrades intended to enhance battlefield situation awareness and targeting capability in in support of commanders and staffs at all Army echelons. Even with the substantial increase in capabilities, the main mission of the CGS is as the JSTARS ground segment.

The CGS, as a system, includes a lightweight, multipurpose shelter housing two operator workstations, a heavy high mobility multipurpose wheeled vehicle (HMMWV) as the mission vehicle, digital and voice radio communications, map digitizer, and six operators to perform mission functions. Power to operate the system comes from commercial sources or from the two 10-kilowatt, tactical, quiet generators mounted on two cargo trailers. The support vehicle is a four-passenger HMMWV. The functions of the CGS are the same as the

previous version with the addition of a Secondary Imagery Dissemination System (SIDS) capability and a remote workstation.

The primary functions of the CGS are to receive, simultaneously store, and display sensor data from the JSTARS E-8C, video from the UAV, and reports from the intelligence broadcast networks (IBN). These capabilities support commanders and staffs at brigade through echelons above corps (EAC) with reconnaissance, surveillance, situation development, battlefield management, force protection, target development, and targeting for deep attack. The CGS receives JSTARS radar data through the surveillance control data link (SCDL) antenna and passes radar service requests (RSRs) to the E-8C through the same path. The CGS disseminates intelligence and targeting information by interfacing with the ASAS, AFATDS or directly with its organic remote workstation. The CGS also receives intelligence broadcast reports through the three-channel commanders tactical terminal (CTT) which is an organic subcomponent of the CGS. The CGS is positioned to support EAC, corps, division, brigades, intelligence organizations, and fire support centers. Other configurations of the system include interface of the CGS internal workstations with two or more CGS, and RWS displays of information in a supported TOC.[26]

The concept of the CGS is to provide an overall picture of the battlefield, including all available intelligence sources to all elements of the staff to include the intelligence section (ACT and S2), the targeting cell (FSO), and the commander or S3. The CGS provides this envisioned assistance by providing support of the following three critical functions.

1. Surveillance and Intelligence: The CGS provides to the brigade level staffs a robust intelligence capability never before seen at this echelon. The capabilities of conducting surveillance can easily be discerned by all the capabilities as listed in the previous several pages. The CGS provides SIGINT, MTI, secondary imagery dissemination (SID), and UAV intelligence which are invaluable intelligence assets at the brigade level in conducting surveillance or other related intelligence functions. The ability to show several intelligence collection sources concurrently on the same screen adds benefit to the ACT, S2, and the staff and commander.

2. Targeting: Targeting is the process of identifying enemy targets for possible engagement and determining the appropriate attack system to be used to capture, destroy, degrade or neutralize the target in question. It is a decision cycle, which incorporates, in abbreviated terms the cycle of decide, detect, and deliver. This means that, (1) one must decide what parts of an enemy force are to be attacked, to what effect, and generally where, when and by what means. Next, (2) these targets must be detected so that they can be engaged. Finally, (3) the friendly force must deliver the combat power or assets (artillery or aviation assets) that achieves the effects desired on the target.

The CGS provides near real-time information with accuracy that is targetable with brigade assets.[27] One aspect that benefits the brigade in the conduct of targeting is that the accuracy of E-8C data increases exponentially the nearer the located target is to the actual flight path of the E-8C. In other words, E-8C data will support brigade-targeting efforts for the close-in fight better than the division and theater level deep fight.

Based upon current doctrine, the CGS primarily has three different intelligence sources from collection systems that meet targetable circular error probabilities (CEP).

(Targeting in these respects includes the use of 155 and 105 artillery, mortars, and helicopter attack.) These include:

A. JSTARS MTI. Primarily utilized for detection and targeting of moving targets, the CGS has the capability to predict location of the targets at a given time based upon the speed and formation of the targets.

B. Tactical reconnaissance intelligence exchange system (TRIXS): (TRIXS is normally associated with SIGINT and communications intelligence (COMINT) received from the guardrail common sensor (GRCS).) GRCS provides tactical reports via tactical electronic intelligence (TACELINT) and tactical reports (TACREP) via the CTT which is an organic hardware and software system of the CGS. The ELINT collected by the GRCS is targetable because of the accuracy provided by the GRCS collection system.

C. UAV electro-optical and infrared (EO/IR)): UAV provides real time imagery of the target after it has been located. Because the telemetry on the CGS screen shows the grid location of the UAV in its flight path, targetiers or the CGS operators must calculate the actual location of the target shown in the video. UAV does provide the near real time capability to adjust fire and to immediately determine battle damage assessment (BDA).

3. Battle management (BM): The definition of battle management has been used widely during the process of Intel XXI and Force XXI development. In regards to the ability of the CGS to support the process, battle management

> includes operations planning, force management and coordination, and direction of C3ISR during mission execution. It spans current operations through future operations to future plans, with the corresponding situation/crisis assessment and operational evaluation at each level. Battle management deals with multiple decision loops including a fast, sensor-to-shooter decision loop that is dealt with

> separately by the Sensor-to-Shooter Working Group. It also deals with complex issues like the uncertainty of large amounts of information and aggregation of many variables into the assessment of progress in achieving a given objective.[28]

The CGS supports BM by providing the commander and staffs an overall view of the battlefield. This is done by utilizing all the sensors that feed the CGS and providing a correlated view of these different sensors to the commander and S3. Key in this is the ability to disseminate this view via the CGS RWS or the situational display screen (SDS) located within the TOC.

The CGS brings a significant technological leap in capabilities to the brigade. As stated earlier, the available intelligence now found at the brigade is equal to what division staffs were receiving in the early 1990s. But, possession of technology does not always ensure its effective use.

CGS Interface Systems

The following outlines the current technical capabilities in relation to the collection systems which provide information and intelligence to the CGS. This includes not only the multifaceted interaction with the E-8C, but also the other interfaces that interact with the CGS. For ease of understanding these have been divided into three separate areas, (1) collection systems, (2) communication links, and (3) processors. As each system is discussed, the impacts upon the CGS will be highlighted.

Collection Systems

1. E-8C (JSTARS): The mission of JSTARS is adequately summarized in the first page from the current FM 34-25-1.

> The primary mission of JSTARS (E-8C) is to provide dedicated support to the Corps commander and other ground commanders, under the overall direction of the Joint Force Commander. With all the additional interfaces, the interface with the E-8C remains as the critical and primary collection system for the CGS.[29]

The JSTARS system is inclusive of airborne, ground, and support segments with the E-8C aircraft operated by the Air Force and the CGS operated by the Army. The airborne segment consists of these major subsystems: an aircraft subsystem, a radar subsystem, an operations and control subsystem, and a communications subsystem. The JSTARS uses radar to detect, locate, track moving and stationary ground targets, slow-moving air targets, and rotating antennas. The E-8C crew controls the radar, monitors and then uses the sensor output to answer taskings from either Air Force or Army elements. The airborne sensor platform transmits multimedia radar imagery data in near-realtime to ground stations at brigade through theater locations using the surveillance and control data link (SCDL).

The radar subsystem of the E-8C is a phased array, multi-mode, side-looking radar system that provides coverage of up to 62,000 square kilometers. This area is referred to as the radar reference coverage area (RRCA). The RRCA moves with the plane as the plane conducts its normal oval loop in the designated area, that is traditionally located thirty to fifty kilometers on the friendly side of the forward line of own troops (FLOT).[30] The radar covers this large area in subsequent swaths as the plane continues in its traditional oval loop.

The radar revisit rate is the time it takes for the radar to complete one swath. Each swath can be equated to one completed picture, depicting the MTI in that swath. This image is then transmitted to the CGS with each following swath sent to the CGS creating the illusion of movement of the MTI over time. The normal swath usually takes 60 to 90 seconds to complete. Depending on the mode of the radar, and the number of taskings the E-8C is attempting to satisfy, the revisit rate historically has ranged from 60

seconds all the way to several minutes. Overall, the longer the revisit rate, the less clarity of the ground picture the CGS operators will receive.[31]

The ground reference coverage area (GRCA) is smaller than the RRCA and is the actual ground area that is under constant surveillance by the radar, regardless of where the E-8C is located in the orbit. "The GRCA generally corresponds to a [typical coverage size] corps area of operations (approximately) 150 kilometers by 150 kilometers."[32] It is the radar imagery from this area that is received by all CGSs no matter which area in the E-8C coverage is related to the area of interest of the CGSs supported headquarters.

As briefly described in chapter 1, the radar has two operating modes, moving target indicator (MTI) and synthetic aperture radar (SAR). During one radar swath, the radar can accomplish both modes, although not simultaneously. MTI is considered as the primary mode of radar operation and is advertised by both the Army and the Air Force as the principal strength of the system. The SAR mode is used to focus in on a specific area providing a literal image of the terrain or fixed (stationary) targets located there.

The E-8C conducts onboard operations with an operations and control subsystem which consists of eighteen operator workstations. These workstations, manned by Air Force and Army crewmembers control the radar, service requests from the CGSs, track targets, send and receive SCDL messages, and provide intelligence information to Air Force elements and agencies. CGS operators will typically interface directly with the Army operators on the plane who in turn communicate with the on board Air Force radar controllers to ensure that the CGS requests are satisfied. The CGS crewmembers transmit radar service requests (RSRs) to the E-8C in order to answer taskings from the

brigade S2 or members of the ACT. The RSRs are responded to by the E-8C crewmembers by providing the imagery requested.

Wide area surveillance (WAS) or the MTI mode is used to detect and, in some cases, identify slow moving ground or air targets.[33] As the radar covers the search area in the WAS mode, it detects and depicts moving vehicles on the E-8C and CGS operators' workstation screens. The radar will depict any object larger than approximately a Volkswagen car moving faster than six kilometers per hour as a dot on the E-8C and CGS operator's screen.[34] This mode is considered the radar's primary operating mode and is considered the cornerstone intelligence product that the CGS provides to the supported headquarters.

MTI has five supporting operating modes that sequentially provide increased resolution and clarity on a smaller portion of the GRCA. Wide area surveillance, which provides coverage of the entire GRCA, is the most common and is the traditional mode used in covering the GRCA. Other modes progressively utilize a higher radar revisit rate that results in higher quality resolution imagery. These modes are sector search (SS), attack planning (AP), attack control (AC), and small area target classification (SATC). Each mode sequentially provides greater resolution and an increase of accuracy of a specified ground area as requested by the CGS operator and selected by the on-board radar operator. Of interest is the fact that the implementation of each additional enhanced radar mode slows down the overall revisit rate of the radar impacting the overall clarity of the ground situation for the CGS operators.

In the SAR mode, a synthetic airborne radar image can be taken anywhere in the RRCA. This radar mode produces a photographic like image or map of selected

geographical regions. SAR imagery provides the most precise targetable imagery locations (as compared to the other radar modes) of larger sized targets such as airfields, bridges, towns or cities, buildings, or large groupings of vehicles. As listed above, it cannot be taken while the other modes of the radar are being used, and significantly slows down the overall swath or revisit rate of the radar. The quality of the SAR image is dependent upon the distance and the look angle of the radar and can be transmitted to the CGS after it has been "shot" by the E-8C. Exact specifications as to the resolution of the SAR imagery is classified, but currently, the resolution is only to the degree that relatively large structures or very large vehicles can be detected using this mode.

Fixed target imagery (FTI), a subcomponent of SAR, is a radar mode that can depict stationary targets as dots overlaid on the SAR image. The FTI display is available (if requested by CGS or E-8C operators) while the radar is operating in the SAR mode. The FTI is displayed as a different colored dot or return on the SAR image. It is typically used by operators to locate vehicles which are assumed to have stopped while being tracked in one of the WAS modes of the radar. Quality of the FTI has been a controversial issue during the past several years. The FTI basically provides a return of any object with a flat side which reflects the radar wave back to the plane. The operators have no means to determine if it is a structure, large stone, or a vehicle.[35]

In the transmittal of information between the CGS and the E-8C, both the CGS and the E-8C have robust communication systems that provide for several modes of communications. Imagery is relayed to the CGS via the surveillance and control data link (SCDL). This is a JSTARS unique, Ku-band, continuous two-way (up and down) data link between the aircraft and the CGS. Only a maximum of fifteen CGSs can be

established in the two way SCDL link while an unlimited number of CGSs can receive the SCDL broadcast. This link broadcasts E-8C data to the CGS, transmits RSRs from the CGSs to the E-8C, transmits digital free-text messages between the CGS and E-8C, and transmits E-8C telemetry data to the CGSs. Both the CGS and the E-8C have ultrahigh frequency (UHF) and very high frequency (VHF) radios to pass and receive voice communications, although the SCDL is considered as the primary communications link between the CGS and the E-8C.

The JSTARS (E-8C) proved its impressive capabilities during Desert Storm. While this type scenario was custom made for the JSTARS based upon the capabilities of the radar system, the Air Force and Army alike have discovered numerous limitations and shortcomings in utilization of the system. Because this is the primary collection system interfacing with the CGS, a short discussion of significant limitations is warranted.

The E-8C:

1. Limited to line of site (limited by terrain).
2. Cannot track dismounted soldiers.
3. Cannot determine type of vehicle as depicted by SAR or MTI.[36]
4. Severe weather creates false radar images which can be misinterpreted by operators as MTI (thunder storms, rain, snow).
5. Heavy vegetation and terrain masks vehicle movement.
6. Severe weather (high winds) will ground the E-8C.
7. Currently there are only three E-8Cs in the 93rd ACW.[37]

The E-8C is the only collection platform (per current doctrine) with which CGS operators are capable of directly sending taskings to and receiving responses.[38] This,

taken in conjunction with the large area of coverage and the type of information provided by the E-8C, makes this a critical collection system with which the CGS interacts.

2. UAV: Interface with the UAV is considered as critical based upon a string of highly successful results noted during several experiments, tests, and demonstrations. One problem remaining though is the fact that the Army has been unable to commit to one specific UAV program. The overall development of the UAV in the Army has been long and tedious, with several different designs evaluated, cancelled, and different programs initiated. As of the writing of this thesis, the Army appeared to be committing itself to the outrider tactical UAV system, which will be a four UAV element of the DS MI Company in direct support of the brigade. [39] As stated in the TRADOC Quarterly update, "The Army plans to acquire 38 - 40 Outrider tactical UAV systems (three to each heavy division, four to each light division and two to each armored cavalry regiment (active component only)."[40] Of note: events in early 1999 have placed into question as to if the Army will buy the outrider. The program has encountered what many believe to insurmountable problems, resulting in the Army placing the program on hold. For the purpose of this thesis, the outrider will be discussed with the assumption that whichever UAV the Army finally acquires and fields will be overall similar to the outrider.[41]

The mission of the tactical outrider UAV is to support tactical commanders with near-real time imagery intelligence at ranges up to 200 kilometers with an endurance four hours per UAV at average altitudes of between 5000 and 15,000 feet. With an estimated turn time (repair and prepare for launch) per UAV of one hour, this gives the brigade the capability to maintain constant UAV coverage and on occasion surge more than one UAV for a short period of time. Collection systems on the UAV are envisioned to be

television (video) and infrared payloads. The outrider system that will be provided to the brigade consists of one system consisting of four air vehicles with sensors and related ground support and control equipment.[42]

The CGS receives UAV video and telemetry via a hardwire connection from the UAV ground control station (GCS).[43] As the UAV flies the required track as controlled by an operator and dictated by the S2 or collection manager, the telemetry and video are transmitted electronically to the UAV GCS, which, via a hard wire connection passes the video and telemetry immediately to the CGS. The CGS operators are then capable of observing the video and telemetry on their monitors, observing the UAV track and look area, and recording the imagery for playback later or making hardcopy pictures to be disseminated as required. Current doctrine dictates that the S2 is responsible for collection management procedures in relation to the UAV. Doctrine also dictates that the CGS operators only receive the video, they are not to directly coordinate and direct the UAV flight path or desired look areas.

The UAV imagery area of coverage is relatively small, basically showing a view at any given time of approximately a one to five kilometer size box as the UAV flies its track. This makes it very hard for operators to locate targets unless it is focused or directed by the S2 based upon his reconnaissance and surveillance plan, or cued by another sensor or other intelligence information. This makes it an ideal system to be used concurrently with the JSTARS system. As the JSTARS depicts movement of a given number of vehicles as MTI, the UAV can be cued to that location to determine the specifics of the reported movement and more accurately identify the vehicles noted by the JSTARS imagery. Based upon comments by Gen. William W. Hartzog, Commander

of Training and Doctrine Command (1997), "JSTARS . . . really is important to getting the big picture." In following comments, he stated; "You fly in the UAV . . . to validate, to see the detail. The two systems [UAV and JSTARS] are indivisible partners."[44]

In reading any after-action report or the results from any of the AWEs or other tests, it is impossible to ignore the accolades heaped upon the UAV by both testers and operational users of the system. Commanders want it, and depend upon it almost to a fault. While the author agrees with the fact that it does have impressive capabilities and is a future essential element at brigade and higher echelons, the system does have limitations which affect the products provided to the CGS.

The UAV:

1. Vulnerable to small arms and ADA weapon systems.
2. Low cloud cover or fog negates the imagery capability.
3. High winds will ground or impact the system.
4. Small window of view by the camera or on board video.

The UAV is the most significant collection asset that the brigade has under its direct control. Because of the relatively small window of view, the UAV's potential is enhanced when other sensors such as the E-8C are used to focus it. A challenge is in the ability of the brigade staff to utilize this system effectively in conjunction with the other capabilities and assets now available to the brigade.

3. IMINT (SIDs): The CGS receives secondary imagery dissemination (SIDs) or imagery by file transfer protocol (FTP), satellite communications (SATCOM), MSE, ASAS, or hardwire communications. This provides the operators and the supported brigade the capability to either request or receive SIDs from other agencies or

headquarters and the ability to construct and send SIDs to higher headquarters or other agencies as required. While the imagery is typically not timely, it still provides useful information reference the terrain, structures, and historical information on unit equipment and logger sites.

Sources of imagery are unlimited. The only constraints are the communications links and the servers that have imagery of use for the staff or commander supported by the CGS. Imagery can range from national sources to images taken with hand-held cameras and scanned into softcopy. The CGS operators have the capability to dial or link into a database, or to retrieve imagery from other CGSs.

Doctrine reference the acquisition and use of imagery by the CGS is still immature since it was not previously available in the previous versions of the CGS. The CGS tactics, techniques and procedures (TTP) states that the CGS can share and provide the imagery to the ASAS, or display the imagery on the SDS or RWS screen. It can also be provided hardcopy for further dissemination, analysis, or use by the supported staff element. The future of this capability, based upon the current doctrine, is not clear. For the near term, the CGS will likely be a simple conduit, passing to imagery to the staff , ASAS, or ACT element, for use and correlation with other intelligence.

Commanders have always wanted to see the picture of the battlefield. In the past, the intelligence community thought it was adequate to simply provide the commander a narrative description of an image, forgoing the complexity of attempting to transmit the actual image to the tactical commander. Since Desert Storm, the intelligence community has reoriented, and now understands the need for actual imagery in the hands of the commanders. With the CGS, this is the first system that provides electronic

dissemination of imagery to the brigade echelon. But, as with every new capability, it does have limitations.

Imagery:

1. SIDS is often not timely, often hours or days old.

2. Transmission time for a single image can take up to 45 minutes, depending upon the source, and the means of transmission (SINCGARS, MSE, or SATCOM).

3. CGS crews are not trained on how to analyze, exploit, or utilize the imagery.

4. The process for requesting imagery by the brigade is not clearly stated in existing doctrine.

5. Even in this new digitized age, bandwidth required for transmitting imagery at the tactical level is severely limited, impacting the ability to share large quantities of imagery or SID products.

The CGS has an excellent capability in receiving, altering, and displaying imagery. The dramatic shortfall is the lack or size of communication links over which to transmit or receive the imagery. Imagery uses extensive bandwidth, and can overload the often-tenuous tactical communication links for extensive periods of time. This eliminates at least one critical communications link for the brigade, and often creates impacts upon the received imagery, reducing the clarity and quality of the received imagery.

4. <u>SIGINT</u>: The CGS receives SIGINT information via the CTT radio. This enables the CGS operators to receive SIGINT data from four intelligence broadcast system networks, which are broadcast by SATCOM and received by the CGSs CTT radio. The four different broadcasts provide SIGINT intelligence from national, sister services, corps and division assets. These broadcasts include:

A. Tactical onboard processing system (TOPS) is a global detection and cueing system from national SIGINT sources for strategic, operational, and tactical support.

B. Tactical data dissemination system (TDDS) is a global detection and cueing system populated by national and strategic systems.

C. Theater intelligence broadcasting system (TIBS) is a tailorable theater level and maintained system populated by sensors such as the RC-135, Rivet Joint, GRCS, Airborne Warning and Control System (AWACS), and the U-2R Senior Scout.

D. Tactical reconnaissance intelligence exchange system (TRIXS) is a tactical targeting system that can be populated by up to five collection systems. The primary sensor for this network is the GRCS which can also serve as a relay for the transmittal of the signal.

The CTT radio receives the listed broadcasts and acts as an interface for the CGS, enabling it to receive and in conjunction with the CGS software and hardware, display and correlate the SIGINT intelligence onto the digital map view. The operators can display this information as icons on a map or in the form of text messages. The CGS operators work in conjunction with the supported S2 and ACT to determine the types of signals to receive and display and the size of the geographical area from which to display the signal data. (Operators can filter the display of the signals intelligence by type of transmitter or by geographical area. This is necessary because of the typical large amount of transmitters located on today's battlefield.)

This is the first instance that brigade level staffs will receive this large amount of signals intelligence. The intent is for the operators and staff to integrate or correlate the signals intelligence with the other intelligence sources received by the CGS. The CGS

can share the SIGINT intelligence with the ASAS as text messages, printed hardcopy showing the emitter locations, or by display on the SDS or RWS screen located within the TOC.

This is the first time that this type of SIGNALS intelligence data has been made available to the maneuver brigade. Doctrinal concepts envision that the operators will use the depiction of the emitter locations in correlation with the MTI data to form a correlated picture of the battlefield or area under observation by the operator or staff. Recent tests conducted by OPTEC indicate that there are, as with the other collection systems which support the CGS, several limitations.

SIGINT:

1. Operators not trained in SIGINT intelligence analysis.
2. Current ACT concept does not include a SIGINT analysts.
3. Majority of SIGINT data is not targetable with brigade assets.

The availability of SIGINT provided to the brigade via the CGS rounds out the intelligence sources the CGS makes available. Utilization by the staff and commander may, in the near term, be limited because of the complex nature of SIGINT data. Also, the overall doctrinal concept of utilization of SIGINT data in the CGS, in conjunction with the other intelligence collection platforms, remains unsound and needs to be further clarified in the future.

Army Aviation: An additional capability of the CGS is the ability to exchange intelligence with the Apache Longbow helicopter. The CGS shares a common link via the integrated data modem (IDM) which allows the CGS to pass and receive imagery or text messages with the Apache Longbow. Currently, the capability and doctrine is for the

CGS to send MTI information to the helicopters prior to and during flight and to receive text and graphical updates from the Apache Longbow. The CGS supporting the aviation brigade can transmit the information to other CGSs, providing current information from the helicopters to the maneuver brigades. Because the CGS at the maneuver brigade will normally have no direct interaction with army aviation, this capability will only be discussed as an exception in the following chapters.

Communications

The CGS has an array of different communications capabilities. This provides the CGS with the capability to interface with the various collection systems and disseminate the formatted intelligence to the various users or processors. A brief discussion of each communication's capability is provided, and will facilitate the reader in understanding in the following chapters.

1. VHF single channel ground and airborne radio system (SINCGARS), AN/VRC-92: The SINCGARS radio provides voice communications and data communications. It can provide data link with the ASAS, AFATDS, serve as a data transmittal link for the passage of SIDS, or be utilized for voice communications with other like radios located in other CGSs or other headquarters.

2. SATCOM (AN/PCS-5): The SATCOM radio provides various communications links to include STACOM relay of E-8C radar imagery and SIDS.

3. IDM: The IDM interfaces with the SINCGARS radio to provide line of sight (LOS) communications with Apache Longbow or any other aircraft that has similar radios.[45]

4. SCDL: The SCDL, as described previously, provide the primary data link between the CGS and the E-8C. It is a LOS communications link vulnerable to interference from trees or terrain.

5. Hardwire links: A reliable communications interface can be established via hardwire or coaxial cable with several of the interface systems to include ASAS, AFATDS, UAV GCS, and the CGS RWS.

6. Intelligence broadcast network: As described previously, the IBN is a series of intelligence communication networks over which several different signals or communication intelligence broadcasts ranging from strategic to tactical are transmitted to a variety of users. In the case of the the CGS, it is capable of receiving four of the existing broadcasts (as described earlier) via the CTT radio which is a receive only radio capable of receiving up to three of the broadcast at any one time.

7. Local or wide area networks (LAN or WAN): Local and wide area networks provide the capability for the CGS to interact with compatible systems such as the ASAS, AFATDS and the Trojan SPIRIT. This is considered the fastest and most reliable means of data sharing and data transmission.

8. Secure telephone unit (STU-III): The system has one STU-III for secure or unsecured voice or data communications and one STU-III fax for secure fax capability. The STU-III, when connected with local commercial phone lines, provides the capability to interface with agencies which do not have compatible interface software with the internal hardware and software components of the CGS.

9. Mobile subscriber element (MSE) KY-68: This communication system provides tactical secure and unsecured voice and data links. The data links are primarily for the transmission of SIDS, AFATDS and ASAS. This also provides a means for operators to communicate with other CGSs or other deployed units via voice.

One apparent limitation that will become quickly obvious to the brigade's signal officer, is the requirement and coordination required to provide the means for all the different communications link. While this is not a serious challenge for higher headquarters, the tactically deployed brigade has limited access to communications links required by the MSE or STU-III. Even though, the numerous modes of communication possibilities provide a range of back-up and secondary possibilities. The impacts these possibilities have on the CGS are therefore overall positive. While the issue of adequate bandwidth for the transmission of imagery and other products remain a concern, the numerous communication options offer a robust capability in providing the CGS and the supported brigade several different routes with which to communicate, transmit, and share data or requirements.

Processors

This section discusses the processing and user related systems to which the CGS disseminates formatted information. While the digitized battlefield provides many variations, only the significant and proven interface options are discussed.

1. AFATDS: AFATDS is an integrated fire support communications and control (C2) system that replaces the previous tactical fire direction computer system (TACFIRE). It processes fire missions and other related information to coordinate and optimize the use of all fire support assets to include mortars, field artillery, missile, attack

helicopters, air support, and naval gunfire. AFATDS provides processing capabilities from the corps to the artillery platoon fire direction center. AFATDS interoperates with all fire support systems and the other ATCCS systems.

Fire missions being processed through the fire support chain when target attack criteria will be matched to the most effective weapon systems available at the lowest echelon. The automation provided by AFATDS increases the maneuver commander's ability to dominate the battle by providing the right mix of firing platforms and munitions to defeat enemy targets based on the commander's guidance and priorities.

AFATDS connects to the CGS via hardwire, LAN, SINCGARS or MSE. The CGS and AFATDS can digitally transmit various message formats enabling the passage of requests for information, information on targets, and requests for fire missions.[46] The messages requesting information from the CGS can be displayed on the CGS screen, indicating the location on which the AFATDS operator is requesting information on potential targets. The AFATDS can then display the message from the CGS showing the location of targets as discerned by the CGS operators with their available information provided by the various collection systems.

Research uncovered two significant issues related to CGS operations in conjunction with the AFATDS. One limitation, which impacts the interconnectivity between AFATDS and CGS, is the fact that they can share information only via message formats. An issue noted in the OPTEC report states; "AFATDS/CGS message exchange is outdated and needs to be reviewed by the users to more effectively utilize the system."[47] A second issue is in the constant training required for operators to maintain a degree of efficiency in operating AFATDS. In discussions with operators, some stated

that they required upwards of eight to sixteen hours of training per week to adequately operate AFATDS.[48] In today's smaller and overtasked Army, this is an unreasonable expectation.

2. ASAS: ASAS is a linchpin intelligence system, forming a seamless intelligence architecture between and across echelons. ASAS is an Army program intended to automate the processing and analysis of intelligence data from all sources. It is a tactically deployable automated data processing (ADP) system designed to support management of IEW operations and target development in battalions, brigades, armored cavalry regiments (ACR), separate brigades, divisions, corps, and echelons above corps (EAC). This provides the brigade's intelligence section the capability to digitally request, analyze, and transmit intelligence to both battalion and division echelons.

The ASAS remote workstation (RWS) is the actual ASAS system located at the brigade and lower echelons. It supports collateral intelligence processing at maneuver brigade S2 and ACT elements. The system is networked to other ASAS systems with two ASAS RWSs located in the ACT and one in the brigade TOC. ASAS-RWS provides the S2 with the means to integrate and disseminate IEW information into the ABCS network. These ASAS RWSs provide the S2 and the ACT the ability to efficiently and effectively process high volumes of perishable combat information and multidiscipline intelligence. This capability in turn supports timely, relevant, accurate, and predictive reporting and dissemination of the common threat picture to other brigade and external functional areas.

The ASAS connects with the CGS by hardwire, MSE, LAN, or the SINCGARS radio. The systems interoperate by sharing preformatted standardized messages. The

internal CGS operator workstations and the CGS RWSs can be connected to the ASAS either by LAN or hardwire connection to receive taskings and pass intelligence reports.[49]

ASAS is a complex system. It has been improved substantially over the years and is very capable of correlating and maintaining an interactive and complete database on the enemy forces. Like AFATDS, operators must conduct constant training on the system in order to maintain a degree of efficiency. In operations with the CGS, OPTEC's report on the CGS is marginally complimentary, stating that the, "CGS interface was technically trouble free throughout the IOTE [initial operational test and evaluation]. Problems were noted when the wrong set of messages were sent to a CGS, missing fields by the CGS operator, and non-standard activity indicators [between the CGS and ASAS]."[50] Another limitation with the CGS and ASAS connectivity is to share imagery between the two systems. The latest version of ASAS software allows imagery from the CGS to be viewed, although the operator cannot manipulate or (via an automated process) extract the useable data from the imagery.

3. <u>CGS RWS</u>: While the RWS is not an actual processor, it is a CGS computer workstation that can be remoted inside the TOC or ACT in order to provide a direct interface between the staff and the CGS operators located in the CGS. The CGS RWS has the same functionality of the two workstations located in the CGS, with the exception of communications functions with other systems and the E-8C.

The RWS connectivity with the CGS is via a hardwire connection. The RWS operator can log onto the system as a third operator, or as a controller, allowing him the option to view either workstations current view located in the CGS.[51]

The RWS is a good idea. It provides the ability to place the CGS view of the battlefield into the TOC. A CGS operator can operate and manipulate the view based upon the face-toface coordinated requirements with the staff. Current limitations are that the RWS is a small laptop SUNSPARK computer. It is slow (as compared to the CGS internal workstations) and the view it provides via the screen is small and difficult to see.

4. Situation Display Screen (SDS): The SDS is a new innovation that is designed to provide a view to the commander and staff located in the TOC digital views from selected systems within the ATCCS network (and other sources as required). It allows the commander to select which view he wants to view and then have it displayed on large display screens located in the TOC. The numbers of screens placed in the TOC are only limited by the availability of these screens and the ability to use the screens in a tactical situation.[52] The CGS and UAV views are typically viewed via these screens. No significant shortcomings reference the SDS are noted.

Summary

The CGS is a complicated system. It provides several new capabilities for the brigade. Prominent is the ability to receive intelligence feeds from several sensors not previously available to the brigade. With digitization increasing the ability of the brigade to share information throughout the brigade's intelligence system and to other nodes, the overall intelligence process at the brigade has become significantly more complex. The descriptions of the various impacts upon the CGS provide adequate background and data that is necessary for analysis of the CGS's architecture and doctrine in chapter 5. Subsequent fallout of the descriptions listed in this chapter is that several issues have already become evident and will be utilized for analysis in chapters 5 and 6. Each of the

different areas discussed above will impact the overall analysis of the CGS as a part of the brigade's intelligence system.

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[1]Claudia J. Kennedy (LG, USA), "Army Intelligence: Focussed on the Future," *Army,* October 1998, 136.

[2]Because of the complexity of the topic at hand, additional background information on the CGS is provided in order to facilitate the overall understanding of the system in this chapter. Discussion of the research design and the overall process of conducting the analysis will be conducted in chapter four.

[3]This statement is based upon personal observations. The author served as the G2 briefer during both Desert Shield and Desert Storm. He personally observed the Command 3rd U.S. Army instruct the G3 to reorient forces based upon the imagery provided by the IGSM and the JSTARS.

[4]Headquarters, Training and Doctrine Command, Pamphlet 525-5, *Force XXI Operations* (Fort Monroe, VA: 1 August, 1994), chapter 2.

[5]Wayne M. Hall (BG USA), "Miscellaneous Thoughts—Threat Panel." (9 August 1998, [ODCSINT Creative Ideas Bulleting Home Page] http://www.inscom.army.smil/mil/odcsint/creative_ideas/voltage/ 27sep98.html), 2. Both TRADOC and the results of the Intelligence XXI study emphasize that future dominant aspects of conventional battlefields are "battle command, extended battle-space, simultaneity, (and) spectrum supremacy" (TRADOC PAM 525-5, chap. 2, pg. 23). This reinforces the stated need for the improvements in technology and doctrine that will support the future conventional battlefields.

[6]Office of the Assistant Secretary of the Army (RDA) "The Army Science and Technology Master Plan" (Washington DC: SARD-TS, 21 March 1997), annex F, pg. 3. The MI Re-look outcome supports this by stating that, "Commanders in Force XXI Decisive Operations will require the capability to "see" their battlespace in depth, to provide a shared common relevant picture of the situation, to precisely locate and track critical targets, to conduct simultaneous attacks with lethal and non-lethal means, to operate with joint and multi-national forces, and to track and protect their own forces. The Intelligence Force of the 21st century--INTEL XXI--must be designed, equipped and trained to meet these demanding requirements. It must be a thoroughly integrated forc--national to tactical, active and reserve--capable of supporting multi-dimensional, simultaneous, dispersed operations." (Headquarters, Training and Doctrine Command, Pamphlet 525-XX, *Force XXI Operations* (final draft). (Fort Monroe, VA: 24 January 1996), 1.)

[7]The recently completed Intelligence Re-look completed by BG Hall supports the basic tenants of Intel XXI. Although in many aspects many of the overall conclusions reached in that study focused on very futuristic concepts, and in many aspects is not immediately relevant to this thesis.

[8]TRADOC PAM 525-5, *Force XXI Operations,* 3-10.

[9]Ibid., 4.

[10]Ibid., 1.

[11]A dynamic tension always exists between technology and doctrine and between strategy and doctrine; they shape one another.

[12]"The CGS is designed, manned, and equipped to provide tactical commanders a single system from which to receive information from a variety of tactical, theater, and national sensors." (Headquarters, Training and Doctrine Command, "Tactics, Techniques and Procedures for the CGS (draft)." (Fort Monroe, VA., 20 February, 1999), 1.)

[13]Ibid., 1.

[14]Headquarters, Training and Doctrine Command, memorandum, *Heavy Force Digital TOC Requirements Narrative Justification* (Fort Monroe, VA: 20 November 1998), 2.

[15]TRADOC PAM 525-5, *Force XXI Operations,* IV-5.

[16]Improvements are also being designed and incorporated at all echelons, national through the tactical echelons. Enhancements in communications and systems in echelons above the brigade will support the maneuver brigade with information passed via the envisioned communications pathways (Trojan SPIRIT), and will be processed by the ACT.

[17]The exact process by which the S2 shop will interact with the ACT has not been defined in the strictest sense. While each brigade will likely develop their own process based upon results from AWEs, the ACT will likely be consolidated with the brigade staff, or at the least located very close in order to facilitate the passing and sharing of information.

[18]In some cases, the S2 may dictate that the CGS locate a operator and a RWS directly in his S2 section, or in the analytical section of the ACT.

[19]U.S. Army, FM 100-5, *Operations* (Washington DC: Headquarters Department of the Army, GPO, 14 June 1993) 1.

[20]Primary means typically refers to a direct link or connection. Secondary input implies that the CGS has the capability to provide information, but only via a secondary means or through another system.

[21]Martin van Creveld, "Command in War" (Cambridge, MA: Harvard University Press, 1985), 269.

[22]With the fielding of the GBCS currently on hold, the majority of DS Companys will continue to operate with their organize TRQ-32s, PRD-10/15s or other ELINT collection system with which they are currently fielded. The delay in the fielding of the GBCS impacts the digital linkage of this ELINT information with the CGS and with ASAS. Any reports generated by the currently fielded systems must be manually typed into ASAS. (GBCS feeds would be automatically fed to ASAS via the CTT radio located in the CGS.

[23]This structure, formerly referred to as the MI Company Team concept, has evolved into the DS Company concept that includes additional collection systems, pre-processors and processors.

[24]Collateral refers to intelligence classified up to the secret level.

[25]CGS TTP, 1.

[26]In linking two or more CGSs, the capability of conducting analysis is substantially increased. It also has the benefit of having only one CGS directly linking with the E-8C, decreasing the potential workload on the E-8Cs radar and crew.

[27]Actual CEP of the MTI, SAR, or FTI data from the E-8 is classified. Accuracy of SIGINT data varies greatly, and in the majority of cases, is not considered as tagetable intelligence with brigade assets. Intelligence provided by SIDS and the other INTS are wholly dependent upon the source and will be dependent upon the S2 or analyst to determine the accuracy of the intelligence provided.

[28]Advanced Battlespace Information System Study Group, *ABIS Task Force Repor--Executive Summary* [internet]; accessed 15 November 1998, available from url: http://www.fas.org/spp/military/docops/defense/abis/ volume1/abis101.gif.

[29]FM 34-25-1, 1.

[30]The use of the E-8C and JSTARS in any theater is totally dependent upon air superiority. The aircraft does not have any defensive countermeasures, and is extraordinarily vulnerable to any type of interdiction. During deployment in support of Operation Joint Endeavor, the E-8C was capable of establishing orbits directly over the areas of interest, although this will not normally be the case in the traditional types of scenarios in which the E-8C will be deployed.

[31]The longer the swath rate equates to an increase in the time that each image of the respective MTI from that swath is sent to the CGS. As each image or swath is depicted on the CGS workstation in consecutive order, the MTI are spaced further apart because of the movement of the vehicles or MTI on the ground, making it increasing more difficult for the operators to track any one target, or a convoy.

[32]CGS TTP, 3.

[33]The E-8C has the capability to provide coverage of an unclassified area of over 32,000 square kilometers (180 kilometers by 180 kilometers).

[34]Any consistent movement such as wires, or wet trees moving in the wind will provide a return. The mode of the radar can be adjusted to lessen the sensitivity negating "clutter" or false returns. Also, a good operator can distinguish between this clutter and actual MTI depicting an actual moving vehicle.

[35]FTI is rarely used or requested by ground station operators. Because of the sensitivity of the radar, the radar depicts any stationary object with a flat surface as a FTI. Because of the numerous returns, which could be anything, the Army ground station operators have been instructed to only use this mode in rare cases.

[36]Although the capability of delineating between wheeled and tracked vehicles is advertised by both the Army and the Air Force, this capability does not work. Although inexperienced operators use it, it is not considered to be a valid capability for those familiar with the system.

[37]Although there are three E-8Cs in the 93rd ACW, only two have an operational radar and the third aircraft is assigned to the Joint Test Center in Melbourne Florida for the purpose of conducting platform enhancement testing.

[38]Some may argue that the CGS has the same capability in interaction with the UAV GCS. While technically this is capable, existing doctrine for the CGS, UAV and brigade intelligence operations depicts the CGS in a receive only mode in regards to the UAV imagery and telemetry.

[39]In the wake of the Hunter termination, DOD awarded a $57-millioncontract in 1996 for six Outrider Tactical UAV systems. DOD will evaluate the military utility of the Outrider through multiservice demonstrations. The demonstrations will determine if Outrider can fulfill the role for which it was originally designed--reconnaissance and surveillance within 50 kilometers--as well as cover the 200-kilometer range that was the Hunter objective. Outrider systems are intended to be fielded with Army brigades and battalions, Navy task forces, and Marine Corps regiments and battalions.

[40]Headquarters, Training and Doctrine Command, *TRADOC Quarterly Update* (Fort Monroe, VA: 4th Quarter 1998. This document was accessed through the internet 15 November 1998. The internet url address is: http://www.tradoc.army.mil/updates /tqu.htm), 7. In February 1999, the Army announced a hold on the Outrider Program based upon difficulties noted during the testing of the system. Future production of this system remains and the overall future of any UAV program in the US Army remains unknown as of March 1999.

[41]The overall trials and tribulations of the UAV program in the US Army are worthy of a detailed and separate study.

[42]DOD had originally planned to examine the military utility of the Outrider system in a series of operational demonstrations. If the operational demonstrations had been successful, DOD had planned to exercise a low-rate initial production contract option for up to 6 systems in third quarter fiscal year 1998. (Government Accounting Office, document, "Unmanned Aerial Vehicles: DOD's Acquisition Efforts" (Testimony, 04/09/97, GAO/T-NSIAD-97-138). 12.)

[43]In Force XXI briefings and papers, the UAV Ground Control Station (GCS),the ground system which controls the UAV while in flight, and receives the down-link of imagery and telemetry from the UAV, is referred to as the Ground Support Element with the same mission. For the purpose of consistency, the author will use the original term of GCS.

[44]William W. Hartzog (GEN USA), interview. *TRADOC commander reveals some results of recent Force XXI AWE.* (Comments made following the 1997 AWE.) (Retrieved from internet site at url: http://www.dtic.mil/armylink/news/Oct1997/ a19971014results.html.), 2. (Of note, the Hunter UAV was an exercise surrogate for the Outrider UAV during the conduct of the test which the General witnessed.)

[45]Future modifications planned for late 2000 are to place the SINCGARS IDM on the E-8C in order to provide a relay communications link with Apache Longbows operating out of ground LOS of the CGS.

[46]The CGS can transmit the following message types to the AFATDS: artillery target intelligence: coordination report (ATI: CDR), fire mission: call for fire (FM:CFF), support datum, and system plain text message (SYS:PTM). The AFATDS can transmit the following message types to the CGS: artillery target intelligence: target criteria (ATI: CRIT), and SYS: PTM. (CGS TTP, 23.)

[47]Headquarters, U.S. Army Operational Test and Evaluation Command, "System Analysis Report for the CGS IOT&E (draft)." (Alexandria, VA: 30 March 1999), 2-106.

[48]This is an issue that will become more common as more systems and process become increasingly automated and more complicated. This issue likely relates to all systems to various degrees.

[49]The CGS can transmit the following message types to ASAS: request for information (RI), response to request for information (RRI), radar exploitation report (REXREP, and free text. CGS can receive and process the following message types from ASAS: multiple asset tasking message (MATM), RI, RRI, and free text.

[50]OPTEC SAR, 89.

[51]The actual RWS is a LAPTOP SUNSPARC computer with a small screen. Also, the RWS works at a considerable slower processing speed than the internal workstations, making operations tedious and discouragingly slow.

[52]The situation display screens are large and cumbersome. In some cases, as in a fairly fast moving offensive operation, it may not be possible for a brigade TOC to move and set up the screens.

CHAPTER 4

RESEARCH DESIGN

> An intelligence system must acquire, process, and dispatch information gained from a variety of sources in time for decision makers to assess what needs to be done and take appropriate actions.[1]
>
> U.S. Air Force University, Air Force Manual 1-1

Introduction

Prior to the 1990s, intelligence systems (at the tactical level) primarily consisted of organic collection systems and analysts who directly received and analyzed the intelligence and information. External sources of intelligence were provided to the brigade from the division in the forms of processed or finished intelligence products. Information, from echelons such as EAC, corps, or in some cases national intelligence, was passed down sequentially, by echelon, to the brigade S2. (See fig 6.) Information, both raw and processed, was received from the lower echelons (battalions) in the form of spot reports obtained by the battalion scouts or from elements in contact with the enemy. While still an overall complicated process, it was relatively easy to determine the processes that were the subcomponents of the intelligence process which then existed.

Today, as Force XXI and the digitized division and brigades concept and equipment becomes the norm, the brigade S2 is provided a significant increase in collection systems, automated intelligence processors, and for the first time, preprocessors. The brigade S2, with an increase in a direct collection capability with organic systems, now has additional direct links to national, EAC, corps, and division collection platforms and products through the CGS and ASAS. While the goal is to enhance the brigade's intelligence capabilities in order to provide the commander

information dominance to support the constructs of Force XXI concepts, it inherently increases the number of processes or possibilities that are now part of the intelligence system in the brigade. The results are a complex intelligence and information network that significantly complicates the intelligence process in the brigade while enhancing the overall intelligence picture for the commander and staff.

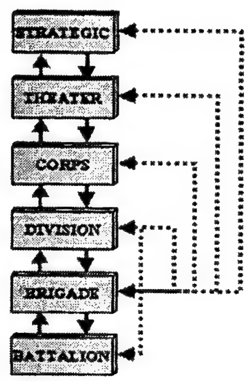

Fig 6. Intelligence flow. Green and Blue lines indicate traditional flow of information and intelligence, with the red and gray lines showing the seamless movement in today's intelligence system.

The CGS as a preprocessor is only one component of this new and complex network.[2] As a preprocessor, the CGS is the central node and entry point into the brigades intelligence system of several different sources of intelligence, which include different collectors from higher echelons. As the most significant intelligence capability provided to the brigade, it is therefore worthy of study to determine if the existing architecture adequately supports the brigade's intelligence system.

Therefore, the CGS will be examined not as a separate and distinct system, but as a piece or element of the brigade's intelligence system. In doing this, the intention is to determine if the CGS's doctrine and architecture are capable and effective in providing

and supporting the overall intelligence process at the brigade level. This will be done in a sequential approach with: (1) the construction of a model to depict the key nodes, (2) determining the connectivity or links between the key nodes, and (3) determining the products and requests that the CGS produces or receives. As this analysis is conducted, external influences on the architecture and the doctrine and the actual operations of the CGS (as discussed in chapter 3), will be examined to determine additional impacts on the final architectural and doctrinal designs of the CGS. If discrepancies are determined during the course of this study, they will be identified as issues with associated (proposed) adjustments or alterations suggested to the existing architecture or doctrine that potentially may fix the noted incongruity.

A Multiphased Research Design

> Even as new intelligence techniques and practices were found and improved upon, the basic processes remained the same: direction, collection, collation, evaluation, interpretation, and dissemination.[3]

The research design utilized in this study is based upon the development of graphic models of the CGS operating as a part of the brigade's intelligence system. The models are based upon the four intelligence process steps (direct, collect, process, and disseminate) and are designed to depict the three key functions of surveillance, targeting, and battle management support the CGS provides to the brigade. The models correspond to the key functions (including the basic starting point model) and form the beginning step in the development of the overall design of the analysis process.

The second step involves constructing and developing the connectivity (links and arcs) within the model and is referred to as the connectivity approach. The links and arcs depicting the intelligence system show the basic information flow, the tasking or request

flow, and interaction to include the standard flow of information and deviations of this flow which impact the CGS and the users of the information provided by the CGS. This step is conducted in conjunction with step three, which determines the flow of information, type of information, and the method by which it is displayed.

Based upon the models and the descriptions of the connectivity developed in the first two steps, the third step uses an information outcome approach to determine what formatted information is passed by the CGS to the users, or requests passed by the users to the CGS.[4] This step also determines the type information received by the users, the way it is displayed, and the parallel process of taskings passed by the users to the CGS. A portion of this step will also determine the impact of brigade external impacts, such as collection assets, which provide information to the CGS that do not fall under direct control of the brigade.

Although referred to as step four, this step is a continuous process, which analyses both the external and internal impacts that impacted the shaping of the CGS doctrine, architecture, and operations. Key to this step is the structure of the brigade and staff, implications of the digitization effort (Force XXI and Intel XXI), and CGS interaction with collection systems and other interfaces. An understanding of impacts is essential not only for the conduct of the analysis, but equally important for the reader in providing a basis for understanding of the conclusions reached based upon the models, and subsequent analysis.

Based upon the information and analysis conducted during the first four steps, the final step is the development of the issues or problems observed in the models caused by the current architecture and doctrine. The purpose is not to recommend simple changes

to software or hardware, but to determine significant issues, which become evident during the course of the analysis. Central elements in developing the issues and the potential fixes will become evident as the first four steps are completed.[5] (See fig 7.)

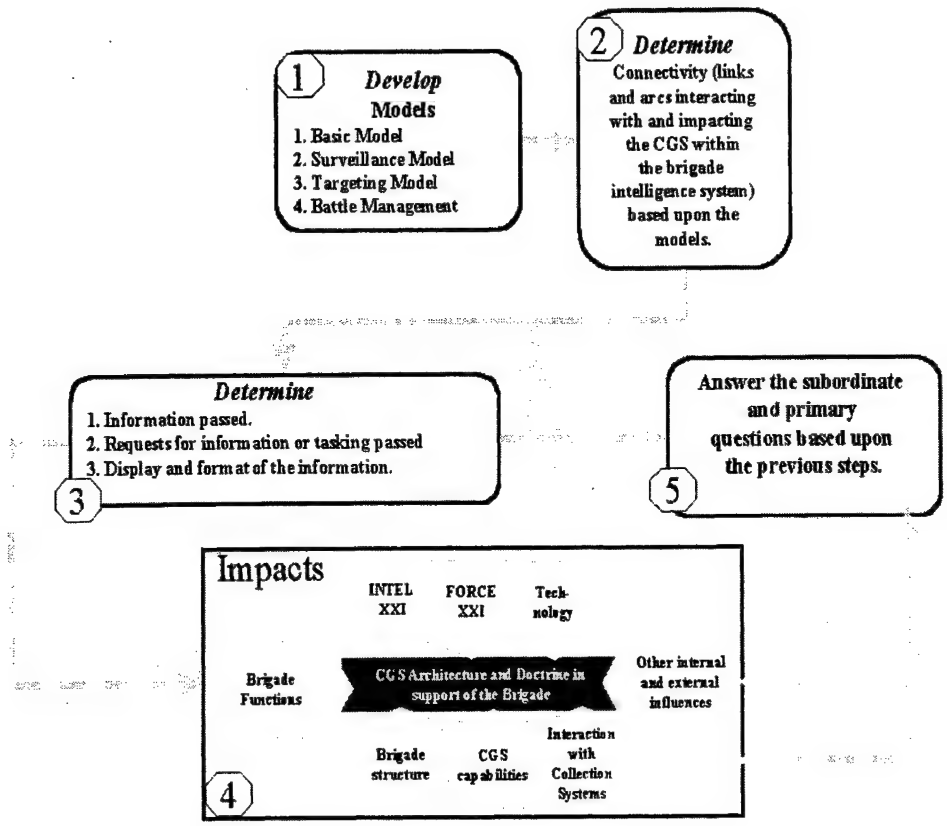

Fig 7. Graphic depiction of the research design as designed by the author.

Why Models

In the most simplistic terms, the intent of an intelligence system at the brigade is to gain information on the enemy in order to support the brigade commander in the conduct of current and future operations. Previously at the brigade, this process was fairly simple since the intelligence manager (S2) normally received a large amount of processed intelligence from higher and had relatively few collection systems under his

direct control. While this limited his capability, overall management of this system was basically simple.

Today's brigade intelligence structure, with the inclusion of the CGS and supporting ACT element, shows an intelligence system at the brigade level that has become incredibly complex, including an increase in collection, preprocessors and processing equipment requiring an increase in management. To be capable of constructing a methodology that will provide focus and provide the required data and analysis to answer the subordinate and primary questions, it is necessary to break the overall system down into the basic constructs of the brigade's intelligence system. To do this and in order to capture the essence of the intelligence flow and impact the CGS has within the brigade, models depicting the flow of information (which includes impacts the CGS), are constructed and utilized as the basis for the study. [6]

The Models

The first step is to develop models that show the interconnectivity and the processes which utilize the CGS within the maneuver brigade when conducting one of the three CGS key functions. Therefore, a model was constructed depicting each of the key functions of the CGS (targeting, surveillance, and battle management) that depicts the critical nodes, links, and potential deviations (arcs) which impact the CGS.[7]

To determine the effectiveness of the architecture and doctrine of the CGS, it is essential that the overarching brigade intelligence system and process be included as the basis of the study. This can be done with the rational that the CGS is a single node of this system, receiving standard messages and information and providing required products through the standard links. While there may be exceptions to the normal flow, variations

can be accounted and described as arcs or deviations, from the standard links. These arcs are used to assist in determining both the effects of the current architecture and doctrine on the CGS and the brigade intelligence system as a whole.

For the purpose of this study basic components of the models are collectors, processors, dissemination, and directing. With the inclusion of the CGS and the ACT element at the brigade the preexisting structure (model) has been changed substantially. This will become evident as the rational behind the construction of the models and the applicable models are discussed and analyzed.

Model one: In order to construct an applicable model that depicts the changes as compared to the previous single thread system, a four-step process dictated by the traditional intelligence cycle was utilized.[8] (See fig. 8.) The generic structure; the basic intelligence cycle utilized by the Army intelligence community, depicts the standard intelligence process, utilized as the basis with which to construct models applicable for depicting the connectivity of the CGS in supporting the three functional areas.

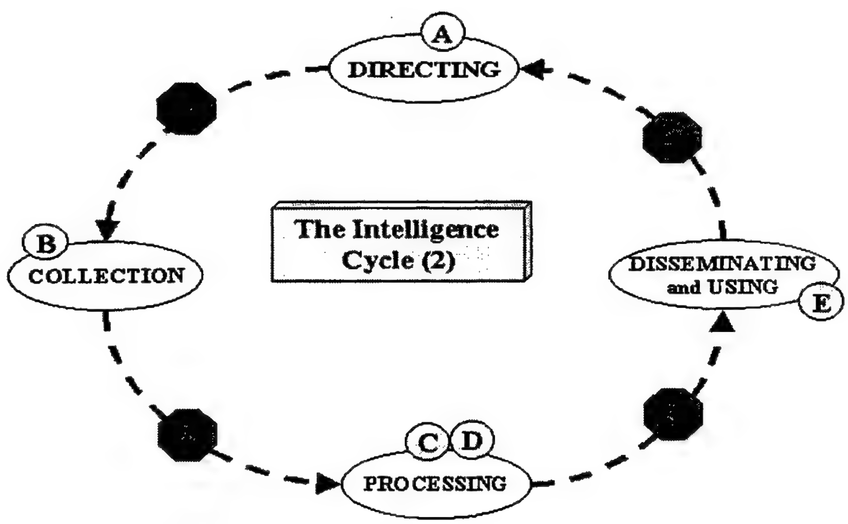

Fig 8. Intelligence cycle model. This model is the base model used in the construction of the following models.

Model two (Basic Model). While the intelligence cycle is a sound starting point, minor modifications are made in model number two, to highlight the uniqueness of the preprocessor versus the processors.[9] Figure 9 depicts the changes, evolving from the previous model from four steps to five steps or nodes. In this model, for clarification, each node is annotated with the system or process that occurs at each node. The only significant changes were in the addition of the preprocessor node and the addition of the word processing in conjunction with production. In this model, each of the nodes are annotated with a letter (A through E) and described in depth in chapter 5. It must be noted that several of the nodes, links and arcs are transitional to each of the different models.

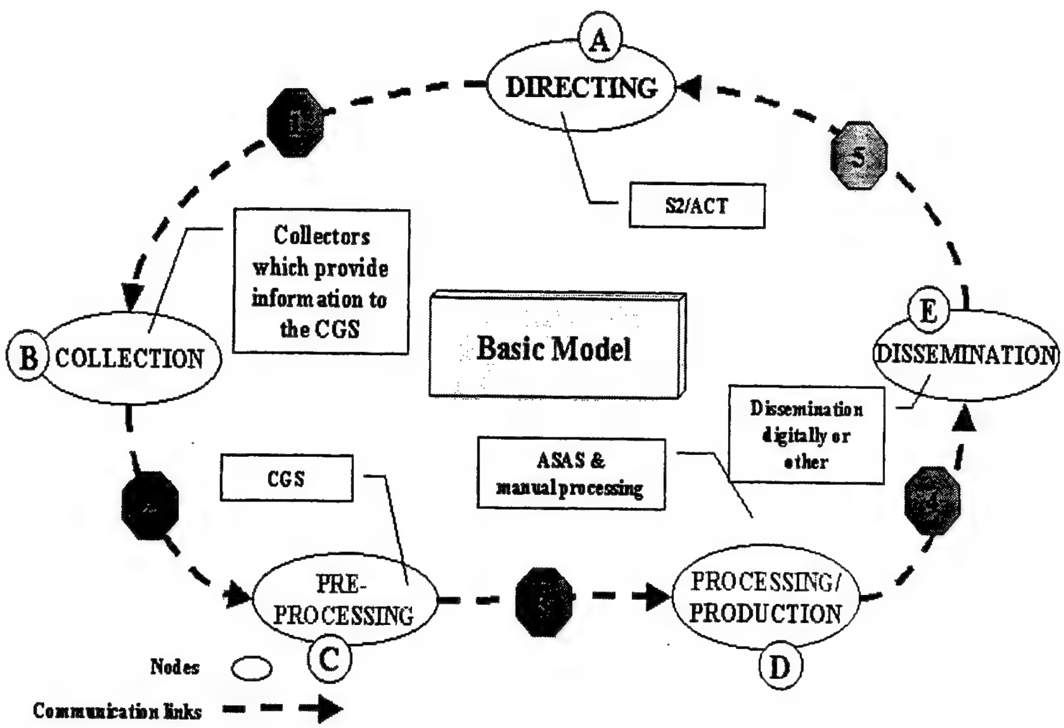

Fig 9. Model two. Modified model depicting the inclusion of the preprocessing node

In model number two (as with the remaining models), the links are depicted by numbers, in conjunction with the nodes, and depict the standard links of message, information, and/or requests flowing within the brigade. As the basic model, there are no arcs or variations depicted. This model shows the very generic link flow (connectivity) taking place within the intelligence system with the various links described in detail in chapter 5.

Model three (Intelligence and Surveillance Model). The third model becomes more complex as permutations caused by support of the intelligence and surveillance functions that can affect the CGS or the overall intelligence process are incorporated. (See fig 10.) Of significance, additional nodes, links, and several arcs are included which makes the model more diverse and complicated when compared to the previous models. Note that there are several additional nodes added because of their affect on the brigade's intelligence system, the collection systems, or their affect on the CGS.

The links and arcs in model three are extensive and are color coded and numbered. The red dashed lines refer to the arcs or the possible connectivity or interaction which may occur, although it is not part of the direct or traditional connectivity, as depicted in model two. (Arcs within this model are occasionally depicted as light gray lines. Their meaning is exactly the same as red indicates. They are changed in color to avoid confusion with the numerous crossing of the links and arcs.) Links with connectivity with external nodes to the brigade intelligence system are depicted as black dashed lines as depicted by links two, three, and six showing connectivity to and from the division echelon. These links and arcs are discussed in depth in chapter 5.

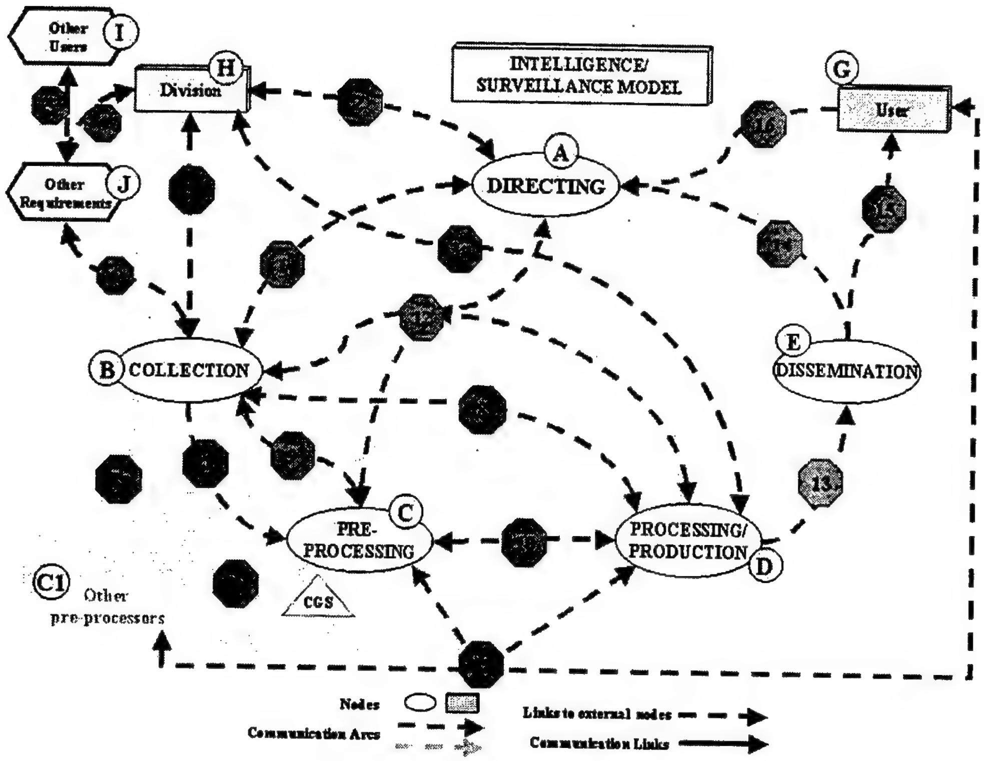

Fig 10. Model three depicting the CGS support to surveillance as part of the intelligence process within the brigade.

In this model, the primary five nodes of the brigade's intelligence process remain the same as discussed in model three. Additional nodes are added to depict other significant impacts on the overall process. In the construction of the model, it was discovered that it is also necessary to develop a step in the process that is referred to as an event as depicted by event J (other requirements). Events are annotated in the models and are described in conjunction with the newly added events and additional nodes as discussed in chapter 5.

Model four (Targeting and Battlefield Management model).[10] The fourth model becomes even more complicated as one additional node is added to the model. This additional node (node F) takes into account the addition of the targeting function of

brigade operations and the changing role of node G (the commander and S3). Of significance, these additional nodes, links, and arcs depict non-intelligence system nodes which have significant impact upon the pre-processor (CGS and UAV GCS). Because of the similarity noted in initial models constructed to separately depict the targeting and battle management process, it was decided to utilize one model to analyze both functions.

In model four, the number of links have increased focussing upon the targeting aspect and the battle management capabilities replicated in this mode. (See fig 11.) The links and arcs are color coded and depicted as described in model four. These are also described in depth in chapter five during the conduct of the analysis.

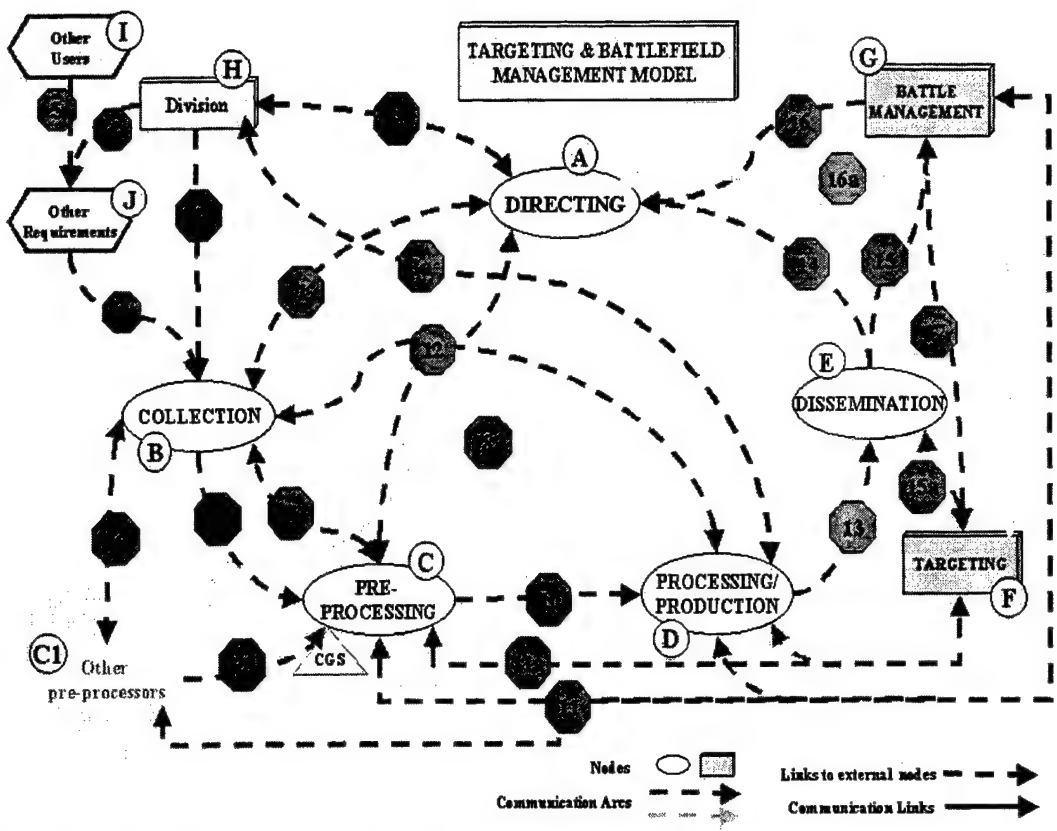

Fig 11. Model four depicting the CGS support to battle management and targeting as part of the brigade intelligence system.

Putting the Models to Work

With the construction of these models, the process of conducting analysis on the connectivity and the information provided by the CGS as part of the brigade intelligence system becomes a relatively simple process. The results of determining the information flow and connectivity are utilized to determine if the existing architecture and doctrine are in place for maximum utilization of the CGS at the brigade. The models also (as will be highlighted in discussion in chapter 5) show the information that is provided by the CGS and other nodes at various points within the brigade's internal intelligence system.

The next step (after construction of the models) involves utilizing the connectivity approach and the information outcome approach to analyze the connectivity of the system, and the information, data, or intelligence the CGS provides to the users at the brigade. By conducting analysis of the models with this method, it is possible to systematically walk through each node and link in the model in order to conduct an analysis of the connectivity and impacts of the established connectivity. And finally by analyzing the information or requests arriving at each key node in the models, it is now possible to thoroughly analyze the CGS architecture and doctrine in relation to the brigade and relevant external and internal impacts. The two components of connectivity and information outcome are discussed for clarification below.

Connectivity. This approach views the CGS as a component of a network (as depicted in the model) in which it receives and passes information and intelligence from point to point within the brigade, and in some cases, outside of the brigade.[11] As a preprocessor the CGS at the brigade is affected by several different sources to include the S2, S3, commander, FSO, and potentially the collection systems themselves. By

modeling the connectivity links within which the CGS functions as part of the brigade information system, it is possible to determine if the internal architecture is adequate in supporting the brigade in the areas of targeting, surveillance and battle management. This type of depiction allows examination as to how the CGS affects or is affected by the messages and information flowing within the intelligence system and determines the impacts that external nodes (external to the intelligence system) has upon the existing structure.

Information outcome. Used concurrently with the connectivity approach, the information outcome approach determines what information is provided by the CGS to the different nodes within the brigade. This assists in determining if the data, information, or intelligence provided by the CGS to the different nodes or users is both adequate, and in a format that can be quickly and efficiently used by that node or staff section.

During the conduct of the research design as described above, the external impacts will be utilized at all times in order to keep the analysis within the scope of the current doctrine, capabilities of the CGS, capabilities of the collection systems, and other external factors. This is a continuous process with no separate step required in the process as described above. The external impacts are described in chapter three and provide the precursor for chapter 5 where this research design is constructed and utilized.

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[1]U.S. Air Force University, Air Force Manual 1-1, *Basic Aerospace Doctrine of the United States Air Force* (Maxwell AFB, AL: Air University Press, 16 March 1984), 2-21.

[2]Some could likely argue that pre-processors have previously existed in the brigade with the existence of platoon operation centers (POCs) receiving and conducting analysis of SIGINT data from the DS Company SIGINT collection systems, such as the

TRQ-32, TLQ-17 or the PRD-10/11. The author discounts this due to the fact that this process was limited, was not automated, and the fact that the POC provided the brigade S2 with analyzed or a finished intelligence product

[3]Oscar W. Koch (BG USA retired) and Robert Hayes, *G-2: Intelligence For Patton* (Philadelphia, PA: Whitmore Publishing Company, 1971), 1.

[4]The term "formatted" refers to a development of information received from the collection systems into a format, which can be sent and utilized by the processor. An example being the CGS receiving the E-8C imagery, and preparing messages describing the activity and sending them to the ASAS. Another example is the same process, but the CGS sending the actual imagery directly to the users SDS.

[5]The rational for utilizing this sequential process is to organize the analysis and results in a logical pattern, ensuring that all areas have been adequately covered.

[6]Because of the complexity of undertaking a study of this nature, the author, through a series of trial and error, determined it was essential to develop a standard model to form basis for the analysis. Without these models, it was quickly determined that the study was not focused nor constrained, allowing for significant variation from the original intent of the study.

[7]Node refers to a collector, preprocessor, processor, user, or other element which receives information, requests information or in some means impact the flow of information coming from the CGS, or effects the operations of the CGS by some means. ARC refers to an alternative or non-common link which may occasionally take place among nodes, effecting or changing the original process as outlined in the model.

[8]Based upon Joint and Air Force doctrinal concepts, the intelligence cycle is defined as having the following five steps: planning and direction, collection, processing, production, and dissemination. For the purposes of this thesis, the author used the army intelligence cycle, which involved four steps.

[9]The author was unable to locate any previous studies of intelligence production, which incorporated the preprocessor concept as part of the model, or study.

[10]In the construction of the models, it was determined that the targeting and the battlefield management models were almost identical. Therefore, the author used one model to conduct the analysis of both of these key functions.

[11]In reference to "outside the brigade" this will typically refer to collection systems that input into the CGS which the brigade S2 does not have direct control over. For example, the CGS at the brigade is capable of interfacing directly with the E-8C that is typically under corps or theater control.

CHAPTER 5

ANALYSIS

> The unresting progress of mankind causes continual change in the weapons; and with that must come a continual change in the manner of fighting.[1]
>
> Rear Admiral Alfred Mahan

Model Based Analysis

The CGS is a new tool provided to the brigade as key part of the brigade's intelligence system. It provides connectivity with five different intelligence feeds, provides some processing capability, and provides the capability to disseminate information to various systems located within the brigade structure. Therefore, in order to analyze the system, the CGS is analyzed as a component of the brigades intelligence system as depicted in the following models.

With the increase in complexity and connectivity of the tools used in the intelligence process in the brigade, conducting analysis of a single system as a separate entity (in this case the CGS), regardless of how it operates within the entire intelligence process or system is no longer valid. A true measure or capability of a system can only be analyzed as a part or element of the intelligence system, which it supports.[2]

An intelligence system is the overall process of determining what information or intelligence is required and then conducting the process of collecting, processing the information into usable intelligence products, and then distributing the resulting intelligence products to users in the brigade staff as readily useable products. In this process, individual systems support each of these tasks as part of the intelligence system. The command and control system conveys requirements into the intelligence process,

which are translated into a brigade collection plan. Collection systems, sensors, ground stations, reconnaissance and surveillance elements execute the collection plan and convey raw information back to processors. Preprocessors receive raw intelligence and in some cases, processed intelligence, which can then be provided to the processors. Processing systems correlate the information, create databases, combine the information from the numerous sources, present a correlated intelligence picture, and then prepares the intelligence into products. The distribution system disseminates this intelligence to the users as directed by the intelligence manager. A variety of communications system supports and link the different systems or steps within the intelligence system by moving the requests, intelligence, and information throughout the intelligence system. Overall, the intelligence system includes all of these elements and steps and attempts to organize and create an overarching structure to this entire process.

Based upon the impact of Force XXI, the digitization effort, and the CGS now located at the brigade echelon, the intelligence system at the brigade has grown with communication links crossing throughout the entire process. It is no longer the smooth and sequential single thread process that previously existed. This also takes the brigade to a new level of situational awareness, meaning that the commander should have an enhanced capability to be aware of not only the enemy situation, but also what his own forces are doing. The analysis process conducted in this chapter will determine if this overall process utilizes the correct architecture and doctrine in reference to the CGS.

Because of the complexity of this process, the results are limited to the significant issues as discovered during the conduct of the analysis. It is impossible, within the constraints of this paper, to discuss all minor shortcomings and limitations of the existing

structure in regards to insignificant software or hardware issues. As the process is discussed sequentially, critical shortcomings and possible areas for improvements in the architecture and doctrine of the CGS become readily evident. Resulting parallel findings show potential problems discovered within the brigade's intelligence system as a whole. Even though, the overall focus of this study remains keyed on the limitations discovered in respect to the CGS.

Background

The model approach utilized provides a method for determining which nodes, links, arcs or deviations warrant analysis and discussion. It provides a systematic method in walking through the intelligence process, with the CGS as an integral part of that system and provides a method for the researcher to determine areas in the process the current architecture and doctrine causes conflict or shortcomings. It is stressed that all possible deviations and possibilities cannot be annotated and therefore are not discussed.

As a starting point, an examination and discussion of the single thread data flow model is essential to create the basis for the subsequent models. By discussing and analyzing the basic model, a commonality is established and shows the significant change introduced with the inclusion of the CGS into the brigade's intelligence system.[3]

This single thread data flow demonstrates the significant difference the introduction of preprocessors creates at the brigade level. (See fig. 12.) Prior to CGSs and UAV GCSs being placed into the maneuver brigade's intelligence system, the process was basically a single thread flow of information with the intelligence manager (S2) tasking the intelligence collection system internally, or requesting intelligence

collection from division or higher echelons. The information was then collected and passed through the system to the processor located at the brigade.

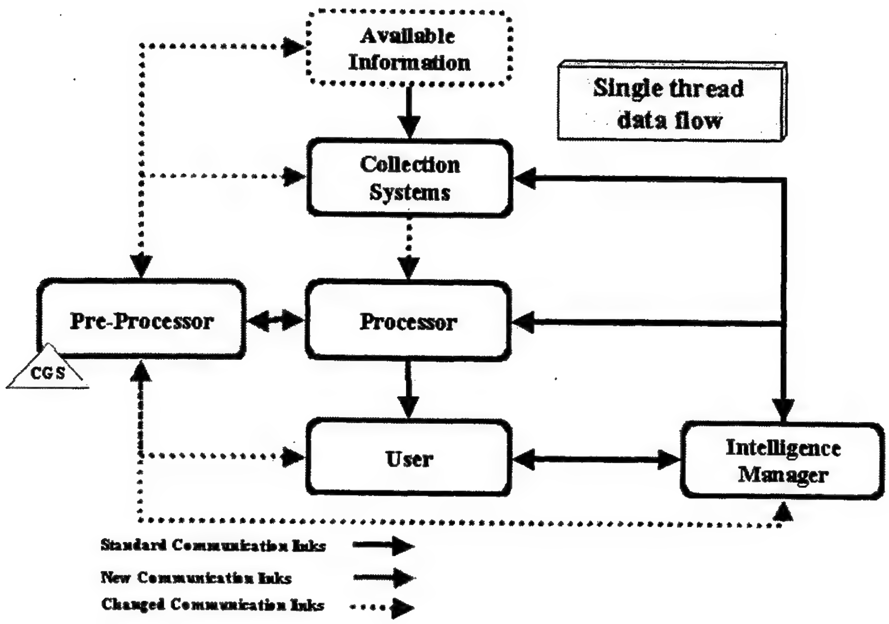


Fig 12. Single Thread Data flow

With the preprocessor (CGS) now located at the brigade, additional steps are introduced (as annotated by the red dashed lines). The preprocessor now has direct links to collection systems and can provide formatted information electronically to the processor, the user, or the intelligence manager. The options for the flow of information within the brigades intelligence system are increased and the preprocessor can be impacted directly by one of several different staff elements to include the S2, targeting cell, or the maneuver control element (battle management).

Based upon the study of this model, it was deemed necessary that alternative models, to accurately depict the CGS in support of the brigade, are required. Therefore, as discussed in chapter four, new models were constructed to provide an accurate depiction of the new brigade intelligence system. The following models were constructed and analyzed in order to satisfy this requirement.

<u>Model One "Intelligence Cycle"</u>

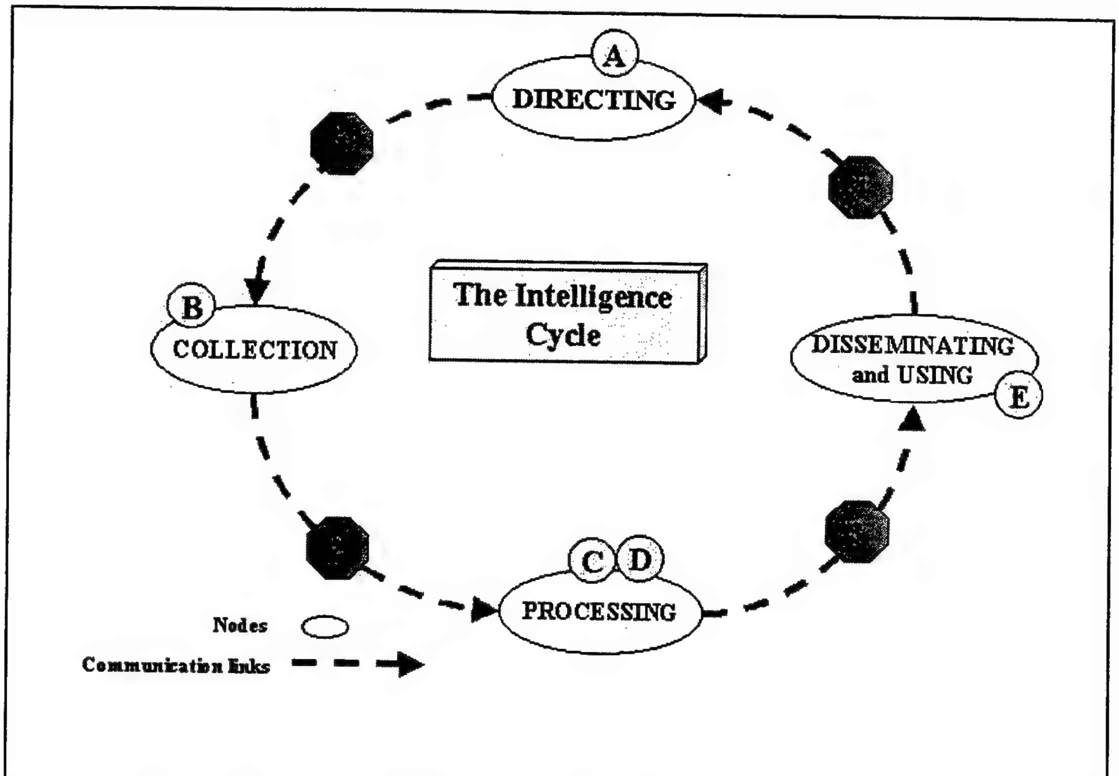
Prior to analyzing the models depicting the CGS in the intelligence system, it is necessary to describe and analyze the initial model used to develop the models used for analysis in this study. By doing this, the author and the reader develop a better understanding of both the construction of the models and the process within the intelligence system which the CGS interoperates. A secondary result is that the reader will also be able to track the changes the CGS brings to the brigade in respect to the structure of the brigade internal intelligence system.

Model one is based upon the traditional intelligence cycle and represents a logical beginning for the development of the subsequent models. It establishes the basis for depicting the nodes and the normal links involved in the process. An added benefit is that the intelligence cycle is readily familiar within the military community and therefore more easily understood, facilitating a common understanding of the model construction and utilization. Description of this model will assist in the understanding both of the intelligence process that is the basis of this analysis and the following models.

In this model, node C and D depict one node or system. This is done in order to facilitate the construction and description of the following models in which nodes C and

D become two separate and distinct nodes. This is also done to show that previously the preprocessing, processing, and production processes were actually one in the same node.

The model outline walks through each of the nodes and associated links of the models. The node column describes the function of each node and the associated element or part of the brigade staff where this node is found. The link column directly corresponds with the associated node and describes the function of the link and the associated means this is done (electronically, face-to-face coordination, or other method). (See fig. 13.)



Model Outline

Node	Link
Node A, Directing: In this model, this node depicts the S2 or the S2's proponent who determines the intelligence requirements based upon analysis of	**Link 1:** Depicts the S2 directing organic collection systems in the collection of information to satisfy requirements. This link can also depict

available data, or the development of requirements by the users whom the S2 supports. Users include, but are not limited to, the S3, commander, FSO, other elements of the brigade staff, or maneuver or support battalion staffs or commanders.	the S2 requesting higher echelons (such as division) for collection support by the higher echelon collection systems.
Node B, Collection: The actual collection of information as required by the brigade's intelligence system. It includes the brigades intelligence system as well as the collection capabilities of higher, lower, and sister elements on the battlefield.	**Link 2:** The passing of collected information being disseminated either electronically or by hardcopy to the brigade's processing node.
Node C and D, Processing: The production of raw intelligence into useable intelligence products in support of the S2 and the other users. It also depicts the inclusion of the intelligence into the intelligence system's processors (ASAS or manual processes) databases. (It is depicted as node C and D in order to facilitate understanding of the following models from which this was developed.)	**Link 3:** The passing of processed intelligence from the processing node into the dissemination channels. This can be done electronically or by hardcopy products produced by the processing node.
Node E, Disseminating and Using: After the raw intelligence is correlated and processed into useable intelligence, it is disseminated to the various users. This is a distinct node because dissemination of the processed intelligence is a deliberate process, which involves the actual decision to disseminate the intelligence to the various users.	**Link 4:** This link depicts two possibilities: (1) the users closing out the requirement (the requirement has been satisfied), or (2) additional requirements being levied against the S2 for coverage based upon the inadequacy of products disseminated or new requirements developed by the user.

Fig 13. Intelligence Cycle model and corresponding description

Analysis and Discussion of Model One

Because this is the base model used in developing the following models, no significant analysis is conducted, except to point out the fact that this model is inadequate to depict the brigade intelligence system based upon the additions of digitization and the CGS to the brigade. It is noteworthy to show that this model is no longer applicable to

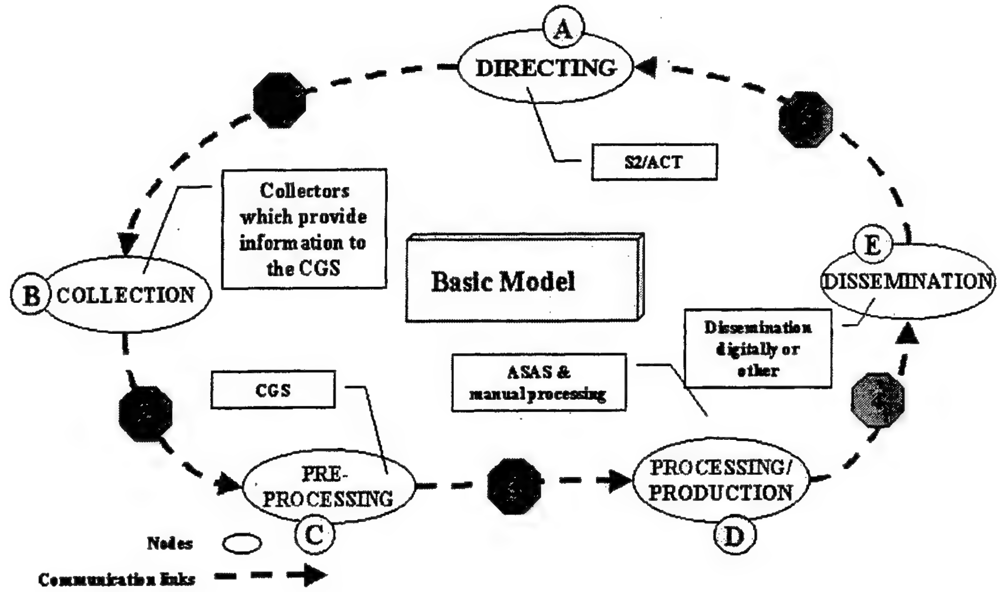
the intelligence process of today due to the introduction of the preprocessor and numerous alternatives it introduces into the overall brigade intelligence system.

With the inclusion of new systems and preprocessors at the brigade echelon and with the enhanced communications, digitization, and the ATTCS systems, this model must be modified in order to conduct the analysis process as described in chapter 4. The intelligence system, with the numerous enhancements previously discussed, can now disseminate the information rapidly either through the standard links (as depicted in this model) or by other arcs or variations of the links.

Model Two "Modified Intelligence Cycle"

Model two is modified from model one in order to account for the inclusion of the preprocessor into the brigade intelligence system. The primary difference is the inclusion of an additional node and link into the overall process. Node C represents the preprocessing system which is now part of the brigade intelligence system as the CGS.

In order to understand the processes involved in the brigade intelligence system, it is necessary to briefly discuss each node and link involved in this model because subsequent variations of this model will be used to conduct the analysis of the CGS. (See fig. 14.) If there is no change in the node or link function from the previous model, its description and purpose will be abbreviated in order to reduce repetition. (Refer to the previous model outline for the complete description.)



Model Outline

Node	Link
Node A, Directing: Directs the intelligence process.	**Link 1**: Tasking or control of collection systems.
Node B, Collection: Collection assets.	**Link 2**: Collection systems passing information to the preprocessors.
Node C, Preprocessing: This shows the inclusion of a preprocessing capability at the brigade. In this model, it is depicted by the CGS, as it receives collected information from the supporting collection systems (E-8C or other or the UAV GCS). This preprocessor manipulates the information into a format and passes the information to the processing and production node via link 3. Node D has the capability to both receive and directly task node C. This places variations into the process which will become more apparent during the analysis conducted of models three and four.	**Link 3**: After the preprocessor receives and formats the information from the collection system, it is passed to the processor (node D) for processing and production. The capability also exists for the preprocessors to pass the formatted information directly into the dissemination node. This will be discussed in depth in the following two models.
Node D, Processing and Production: Processing and production of the information into useable intelligence products, or correlation into the database, for current and future analysis.	**Link 4:** Passing of intelligence products into the dissemination process.

Node E, Disseminating and Using:	Link 5: The process by which the
Dissemination of intelligence products to the various users.	processed intelligence is disseminated.

Fig 14. Modified Intelligence Cycle model and corresponding description.

Analysis and Discussion

This model shows the first deviation in the standard model and warrants discussion in order to determine if there are any critical issues which may impact the analysis conducted on the following models. This model sequentially builds upon the previous model in providing the foundation for the following models that are necessary to answering the overall research question.

The CGS as a component of the preprocessing node inputs information, both raw and processed, into the brigades intelligence system. The CGS has the capability to display the various intelligence products on the operator's screens, but the operators cannot share their correlated view of all the intelligence feeds directly with the processing node (ASAS). The CGS operators can send message formats describing what the operators are seeing, but the overall picture is not readily shared with the ASAS. This fact will become further evident during analysis of the models three and four.

Another significant fact, although not readily apparent in this model, is that numerous collection systems are providing a wide range of intelligence, both processed and raw intelligence, into the preprocessor. These intelligence collection systems include assets such as the electronic collection systems that are available as part of the DS MI CO, the brigade scout platoon, higher echelon collection systems, and others. These collection systems may pass their information through the preprocessing node, with some of the information going directly to the processing node or the user.

The CGS as a preprocessor has the capability to communicate and send direct requests to or for two different type of collectors, that being the E-8C and in the ability to request and receive imagery products. The remaining intelligence is simply received by the CGS via a direct link or broadcast dissemination. The CGS does not have the capability to request specifics or clarification to these systems which include the intelligence broadcast network (which provides SIGINT processed data) and the UAV. This is critical to keep in mind as the following models are described and discussed.

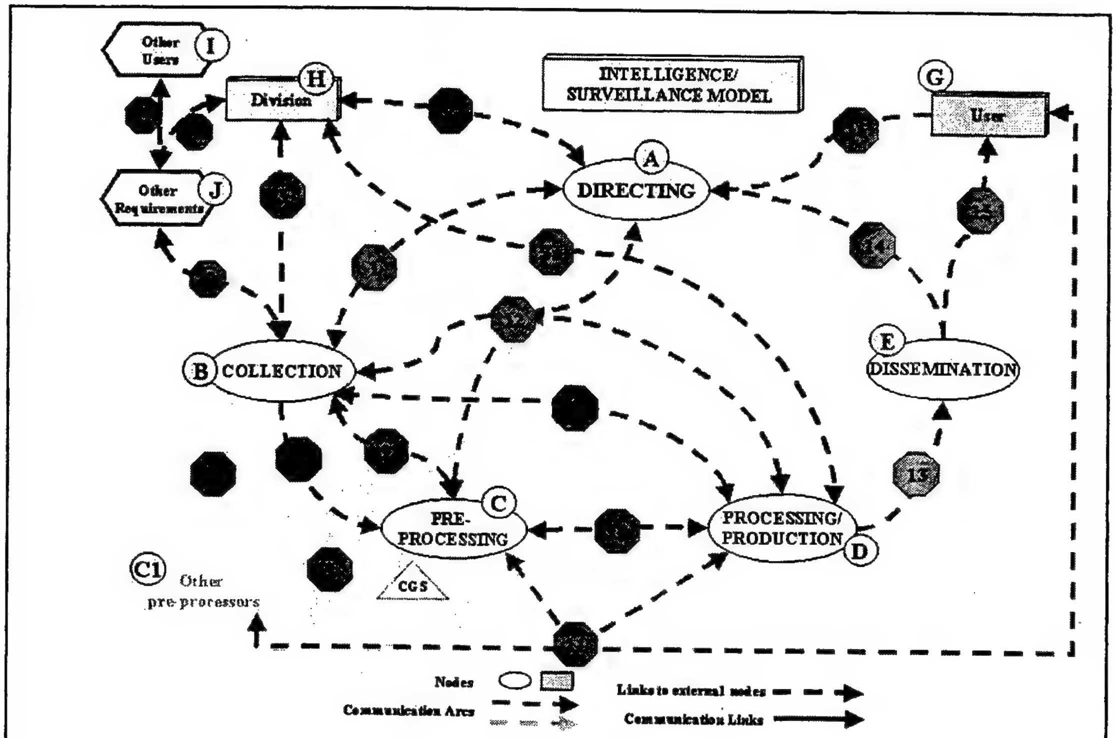
This now sets the stage for the construction and analysis of the final two models. This basic structure must be kept in mind, with the focus on node C which replicates the CGS and the UAV GCS, in order for the reader to maintain an understanding of the differences and impacts introduced with the inclusion of the preprocessor into the brigades intelligence system.

Model three "Surveillance and Intelligence"

Model three depicts an accurate model of the brigade's intelligence process with the CGS in support of the surveillance and intelligence function. It becomes quickly obvious how complex this model is with the incorporation of digitization and enhanced communication which provides the capability of data and information to be passed outside of the preexisting formal channels as outlined in model two.

In the construction of this model, the basic format used in the previous two models is utilized. To facilitate analysis, the model is shown, a table (model outline) describing the nodes, links, and arcs as depicted in the model, followed by analysis and discussion of the areas where potential discrepancies are discussed. This systematic flow facilitates the analysis and the readers understanding of the analysis conducted. As in the

previous model outline, nodes or links with the same purpose or function are only briefly described, although some links have additional or slightly changed functions and therefore are fully annotated. (See fig. 15.)



Model Outline

Node	Link
Node A, Directing: Directs the brigade's intelligence process.	**Link 1:** The S2 directing organic collection systems in the collection of information to satisfy the requirements. **Link 2:** The brigade S2 requests directly to the division for intelligence collection support or processed intelligence products.

Node H: Division or higher echelon node. This is a node external to the brigade intelligence system. The division intelligence system with which the brigades S2 and ACT have direct (external) interface with. This node provides processed intelligence and receives requests for additional division or higher echelon intelligence collection.	**Link 3:** The division tasking the collection systems in order to support the intelligence requirements received from the brigade. **Link 4:** Depiction of the division development of other requirements to support division specific intelligence requirements.
Node I: Other users: This node shows other potential users of collection systems. These can include other brigades or other units subordinate to the brigade. In relation to the E-8C, it can depict any user throughout the corps, who required E-8C collection.	**Link 5:** Development of taskings for the collection systems.
Event J: Other requirements. This event depicts other requirements developed by other users against the collection systems. This relates, for the purpose of this study, primarily to the E-8C.	**Link 6**: The tasking of other requirements against the collection systems.
Node B, Collection: The actual collection of information as required by the brigade or division intelligence system. It includes the brigade's intelligence system as well as the collection capabilities of higher, lower, and sister elements on the battlefield.	**Link 7:** The passing of collected information being passed either electronically or by hardcopy to the brigades preprocessing node. In this model it depicts collected intelligence being passed to the CGS. **Link 7a:** The UAV control and video link between the UAV collection system and the UAV's ground control station. **Arc 9:** This arc depicts the that in some cases, such as the E-8C, the crew on the has the capability of interacting verbally and via electronic messages with the CGS crew in order to verify requests or to gain a clarification on the ground situation.
	Arc 8: The capability, in some cases, for information from collection systems to be passed directly to the ASAS or the brigade's processing element in the ACT. (Bypassing the preprocessors.)

	Arc 12: This arc depicts that the brigade S2 has the capability of impacting the process or is impacted by the process. He can alter requests, impact the production, or change the focus at any time in the process.
Node C, Preprocessing: The preprocessing capability at the brigade. This node receives the down links from several different collection systems. In this model, this can be replicated by the CGS, as it receives information from the E-8C or other systems as previously discussed. This preprocessor manipulates the information into a format and passes the information to the processing and production node.	**Link 10:** After the preprocessor receives and formats the information from the collection system, it is passed to the processor (node D) for processing. **Arc 7b:** The UAV GCS, via hardwire, passes the UAV video and telemetry to the CGS. **Arc 9:** The capability to interface directly with the collection system such as the E-8C or UAV GCS. This provides the preprocessor operators the capability of requesting specific coverage or refocusing the collection of the UAV platform. **Arc 12:** The brigade S2 has the capability of impacting the process, or impacted by the process. In relation to this node, he has the ability to directly view near real time E-8C information being passed to the CGS and alters the operator's requirements as required. He can also view the UAV video since it is passed directly to the CGS and can be passed directly into the TOC. **Arc 11:** The CGS can pass the view as seen by the operators directly to the users via the RWS or SDS. The users can change or request different views, or levy additional requirements.

Node C1, Other preprocessor: A variation to the original model, this node represents the UAV GCS, which provides formatted UAV video and other UAV products to the CGS. This situation has one preprocessor (the UAV GCS) passing information to another preprocessor (the CGS). This node, in theory, is a part of the preprocessing node, but for accurate analysis of the intelligence system that the CGS operates within, it is more accurate to depict this additional preprocessor as a separate entity.	**Link 7b:** In this model, the UAV is passing formatted UAV video to the CGS. Of note, the CGS operators do not have a direct process of impacting the collection of the UAV. The CGS is simply a receive node as linked to the UAV GCS. **Arc 7a:** UAV passing video and being controlled by the UAV GCS. **Link 12:** This arc shows that the brigade S2 has the capability of impacting the process, or is impacted by the process, deviating from the normal process. In relation to this node, he has the ability to directly view near real time UAV video being passed to the GCS and alters the UAV flight path or look area if required. **Arc 11:** The UAV GCS can pass the view as seen by the operators directly to the users via a RWS or SDS. The users can change or request different views or levy different requirements.
Node D, Processing/Production: This node depicts the forming of raw intelligence into useable intelligence products to support the S2 and the other users. It also depicts the inclusion of the intelligence into the intelligence systems processors.	**Link 13:** This link depicts the passing of processed intelligence from the processing node into dissemination channels. This can be done electronically or by hardcopy products produced by the processing node. **Link 3a:** With ASAS, the brigade is capable of receiving processed intelligence from the division and higher echelons. At this node, the brigade ASAS is also capable of requesting intelligence products and disseminating the brigade's picture of the battlefield to subordinate battalions or the division.

	Arc 12: The brigade S2 has the capability of impacting the process, or is impacted by the process, at this node. The S2 can view an alter the correlated view being constructed by the ACT utilizing the ASAS. **Arc 8:** Some collection systems, primarily organic to the brigade do not require a preprocessor, with the collected data passed directly to the processing and production node. An example of this would be the brigade scouts or SIGINT collected by the brigade's organic assets. External assets such as HUMINT reports may also be passed directly in the form of a message the to brigade's processing node. **Arc 11:** At times, the ASAS picture or view may be displayed to the users by means of the SDS. The user will at this time have the capability of impacting the ASAS operations directly, potentially without coordination with the brigade S2. **Link 10:** Traditional flow of formatted information from the preprocessors to the processing node. These are normally formatted messages. Hard copy imagery can also be manually passed to the processing node, or a UAV or CGS RWS can provide a live view.
Node E, Dissemination: After the raw intelligence is correlated and processed into useable intelligence, it is disseminated to the various users. This is a distinct node because dissemination of the processed intelligence is a deliberate process which involves the actual decision to disseminate the intelligence to the users.	**Link 14:** This link depicts two possibilities: (1) the users closing out the requirement for further collection (the requirement has been satisfied), or (2) additional requirements being levied against the S2 for coverage based upon what was disseminated to users, or new requirements developed by the user.

	Arc 15: Although part of the dissemination process, node D has the capability of sending processed intelligence directly to the user. For example, directly from ASAS to MCS, or by the ASAS view displayed on the SDS screen in the TOC. **Link 13:** Traditional dissemination procedures.
Node G, users (commander, S3, FSO, or other elements of the brigade staff): Users are depicted to show the interaction that the CGS will have with the user and the reverse process of the user's impact on the CGS. This shows that the user now has the capability to impact the intelligence system early in the process (at node C and C1). The user continues to receive the intelligence via the more normal process as annotated by arc 15. This gives the user the capability to directly interface or impact the information being provided by the preprocessor and the collection system or the processed intelligence being produced by the processing node.	**Arc 16**: The user interfacing with the S2 in determining requirements. With the inclusion of the preprocessors and enhanced collection systems at the brigade, it is evident that the user (S3, commander, FSO) will be significantly more involved in the direction and control of collection systems. **Arc 11:** The user receives a view of the information being formatted by the preprocessors and processors prior to the information completing the entire intelligence process. This is done via the RWS, SDS or by the interconnectivity between ASAS and the MCS or the other ATCCS. **Arc 15:** Dissemination of processed intelligence to the user.

Figure 15. Intelligence and Surveillance, model and corresponding description.

Analysis and Discussion

Conducting analysis with this model sets the tone in showing the numerous interactions that take place within the brigade's intelligence system in regards to the CGS. As compared to the previous model, the inclusion of a preprocessing node, in conjunction with the ATCSS systems, makes this model very complex. The interactions and processes are no longer streamlined in one logical process, information and requests

for information now flow through various paths external to the previous process as depicted in model three.[4]

It is quickly noted that the preprocessing node now has additional links or arcs providing it the capability to share information directly with the user. This may, on occasion, present the user with raw information versus processed intelligence. This has the potential of not providing the commander or staffs a complete and accurate picture of the battlefield. The commander or staff may react to information provided by only one intelligence source which may turn out to be inaccurate.

This model also points out that the one common node where all information from collection and the division flows to is the processing node. Therefore it is proposed that the processing node is the only node with a complete and accurate intelligence picture depicting most accurately the intelligence picture of the brigade's area of operation. Consequently, this node should be the primary source of disseminating all intelligence or information to the S2 and the users.

Additionally, the directing node (S2) responsibilities have increased substantially. This node must control this increase in collection assets, manage the preprocessors, and interface with all the other nodes in the intelligence system. The overall workload of the S2, therefore, has been substantially increased. The increase of assets provided by the ACT will assist in management, but based upon the model and personal experience, there continues to be a requirement for one central intelligence node controlling and influencing the overall intelligence system within the brigade. This is an area of recommended further research.

The bottom line reference this model is: does it support the brigade in the execution of the surveillance function? The numerous collection assets, which provide input to the CGS, provide adequate information for supporting the surveillance function. The E-8C provides large area surveillance depicting all moving vehicles while the UAV can be focused in to the targets to add the detail required. The signals intelligence received via the CTT is an additional tool which can be used to assist in developing a fairly accurate picture of the battlefield. In combining the information provided by these different collection systems, the CGS does have the capability to support the surveillance function at brigade.

In regards to the surveillance question, a shortcoming noted is the fact the CGS operators, not trained as analysts, do not understand the different intelligence information provided to the CGS and therefore do not adequately combine or correlate this information into one fused product. They simply respond to requests and provide simple message replies to taskings, or provide the different views as requested by the users, S2 or the ACT. The end result is that the CGS operators are simply providing information to the S2, ACT, processing node, and the users. It should not be forgotten that "information is not intelligence, let's not confuse the two."[5] Interchanging either information and intelligence can have serious consequences if the users are misled as to the actual products or information received from the CGS.

As the volume of information received and collected by the maneuver brigade increases, so has the requirement to put it together in a format that is both understood and useful by the commander and staff. As stated by BG William E. Harmon, USA, Program Manager for the joint tactical fusion program: "The most sophisticated intelligence

collector in the world is worthless if the information it provides does not reach the commander in a timely manner . . . . The US has very efficient battlefield intelligence collection systems today, but management of those collection assets and the processing of their information are extremely inefficient."[6] This appears to be one of the principal shortcoming of the CGS in not only supporting the surveillance function in the brigade, but also the following two functions discussed in model four.

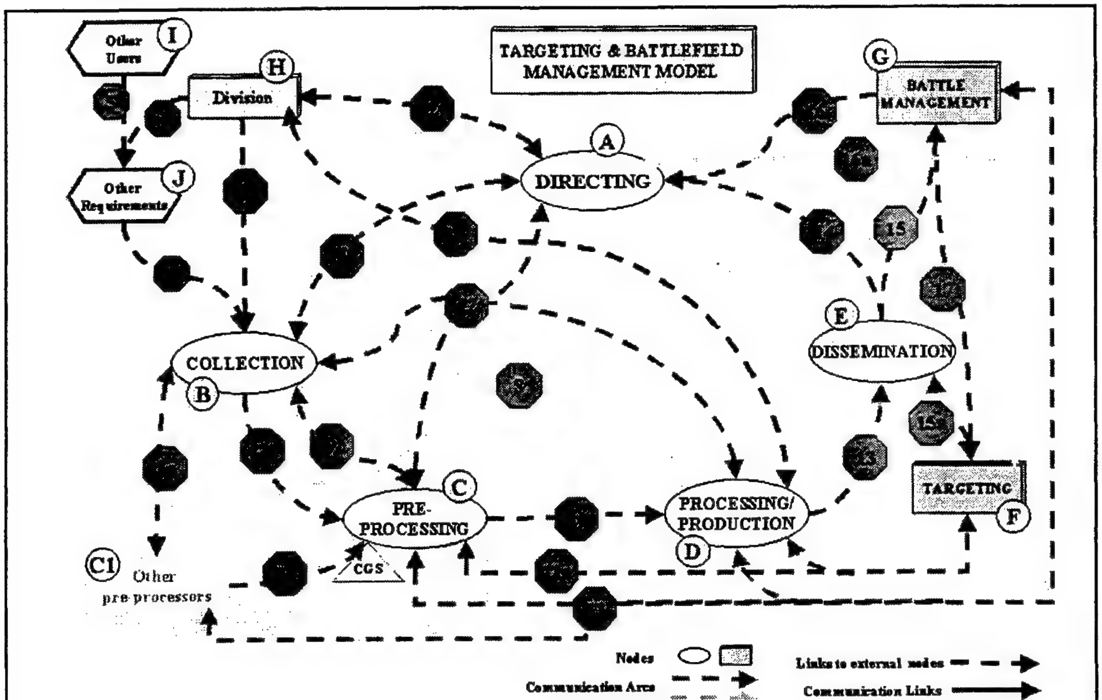
Model four "Battle Management and Targeting"

Model four continues the process by outlining the next two areas under study, the functions of targeting and battle management. This is an even more complex model, with the addition of one node into the process and the node previously referred to as users, now depicted as battle management. The numbers of links and arcs have also increased substantially. The complexity is due to the ATTCS systems now supporting the battle management and targeting functions, digitization of the brigade's command and control system, and the brigades more complex internal intelligence system.

The similarity of the targeting and battle management functions and the fact that they are interrelated functions from the perspective of the intelligence system, provided the opportunity for one model to be utilized in discussing and analyzing both of these functions. In some cases, the specific processes conducted at the different nodes or links will be different, dependent upon whether support is being provided to targeting or to battle management. In these cases, the differences will be described in the model outline that describes the processes involved in this model.

In construction of the model outline, the same systematic approach used to construct and describe the previous models was utilized. Many of the nodes and links

retain the same function as depicted previous models, with some having been altered to more accurately depict the specific function of supporting the battle management and targeting functions. In the conduct of the analysis, each function is discussed separately in order to aid in the understanding of specific problems inherent with the conduct of each separate function. (See fig. 16.)



Model Outline

Node	Link
Node A, Directing: Directs the brigade's intelligence process.	**Link 1:** The S2 directing organic collection systems in the collection of information to satisfy the requirements.

	Link 2: The brigade S2 requests, directly to the division, for intelligence collection support or processed intelligence products.
Node H, Division or higher echelon node: This is a node external to the brigade intelligence system. It is the division intelligence system with which the brigades S2 and ACT have direct (external) interface with. This node provides processed intelligence and receives requests for additional division or higher echelon intelligence collection support.	**Link 3:** The division tasking the collection systems in order to support the intelligence requirements received from the brigade. **Link 4:** Depiction of the divisions' development of other requirements to support division specific intelligence requirements.
Node I, Other users: This node shows other potential users of collection systems. These can include other brigades or other units subordinate to the brigade. In relation to the E-8C, it can depict any user within the corps and sister services who require E-8C collection support.	**Link 5:** Development of taskings for the collection systems.
Event J, Other requirements: This event depicts other requirements developed by other users for the collection systems. This relates, for the purpose of this study, primarily to the E-8C.	**Link 6:** The tasking of other requirements against the collection systems.
Node B, Collection: The actual collection of information as required by the brigade or division intelligence system. It includes the brigade's internal intelligence system as well as the collection capabilities of higher, lower, and sister elements on the battlefield.	**Link 7:** The dissemination of collected information electronically to the brigade's preprocessing node. In this model it depicts collected intelligence from the E-8C, SIGINT, or other collection assets being passed to the CGS. **Link 7a:** The UAV control and video link between the UAV collection system and the UAV's ground control station.

	Arc 9: This arc depicts the fact that in some cases, such as the E-8C, the crew on the E-8C has the capability of interacting verbally and via electronic preformatted messages with the CGS crew in order to verify requests, or to gain clarification on the ground situation. **Arc 8:** The capability, in some cases, for information from collection systems to be passed directly to the ASAS or the brigade's processing element in the ACT. (Bypassing the preprocessors.) **Arc 12:** This arc shows that the brigade S2 has the capability of impacting the process, or is impacted by the process. He can alter requests, impact the production, or change the focus at any time in the process.
Node C, Preprocessing: The preprocessing capability within the brigade. This node receives the downlink from several different collection systems. In this model, this can be replicated by the CGS as it receives collected information from the E-8C or other systems as previously discussed. This preprocessor manipulates the information into various formats and passes the information to the processing and production node.	**Link 10:** After the preprocessor receives and formats the information from the collection system, it is passed to the processor (node D) for processing. **Arc 7b:** The UAV GCS, via hardwire, passes the UAV video and telemetry to the CGS. **Arc 9:** The capability to interface directly with the collection system such as the E-8C or UAV. This provides the preprocessor operators the capability to request specific coverage or refocus the collection by the different collection platforms. **Arc 12:** The brigade S2 has the capability of impacting the process, or is impacted by the process. In relation to this node, he has the ability to directly view near real time E-8C information being passed to the CGS, and alters the operator's taskings as required. He can also view the UAV video since it is passed directly to the CGS or the SDS within the TOC.

	Arc 11a: This arc shows the link that the CGS has with the targeting node via the AFATDS. The CGS and the AFATDS share information via standard message formats. **Arc 11:** The CGS can pass the view as seen by the operators directly to the users with the RWS or SDS. The users can change or request different views, or levy different requirements to the CGS crew.
Node C1, Other preprocessors: As variation to the original model, this node represents the UAV GCS, providing formatted UAV video and telemetry to the CGS. Therefore, one preprocessor (the UAV GCS) is passing information to another preprocessor (the CGS). This node, in theory, is a part of the preprocessing node, but to construct an accurate model to facilitate accurate analysis of the intelligence process, it is more accurate to depict this additional preprocessor as a separate entity.	**Link 7b:** In this model, the UAV is passing formatted UAV video and telemetry to the CGS. Of note, the CGS operators do not have a direct capability of impacting the collection of the UAV. The CGS is simply a receive node slaved to the UAV GCS. **Link 12:** This arc depicts that the brigade S2 has the capability of impacting the process, or is impacted by the process, deviating from the normal process. **Arc 11:** The UAV GCS can pass the view as seen by the operators directly to the users via a RWS or SDS. The users can change or request different views or requirements.
Node D, Processing and Production: This node depicts the development of raw intelligence into useable intelligence products to support the S2 and the other users. It also depicts the inclusion of intelligence into the intelligence systems processors.	**Link 13:** This link depicts the passing of processed intelligence from the processing node into dissemination channels. This can be done electronically or by hardcopy products produced by the processing and production node. **Link 3a:** With ASAS, the brigade is capable of receiving processed intelligence from the division and higher echelons, as well as the subordinate battalions. At this node, the brigade ASAS is also capable of requesting intelligence products and disseminating the brigade's picture of the battlefield to the division and subordinate elements.

Arc 12: The brigade S2 has the capability of impacting the process, or is impacted by the process, at this node. The S2 can alter the correlated view being constructed by the ACT utilizing the ASAS.

Arc 8: Some collection systems, primarily those which are organic to the brigade, do not require a preprocessor and the collected data is passed directly to the processing and production node. An example of this would be the brigade scouts or other information collected by the brigade's organic assets. External assets such as HUMINT reports may also be passed directly in the form of a message to the brigade's processing node.

Arc 11: At times, the ASAS picture may be displayed to the users by means of the SDS. The user, will at this time, have the capability of impacting the ASAS operations directly and potentially without coordination with the brigade S2.

Arc 11a: This shows the link that the ASAS has with the targeting node via the AFATDS. The ASAS and the AFATDS share information electronically via standard message formats.

Link 10: Traditional flow of formatted information from the preprocessors to the processing node. These are normally preformatted messages. Hard copy imagery can also be manually passed to the processing node, or a UAV or CGS RWS can provide a live view directly to the TOC.

Node E, Dissemination: After the raw intelligence is correlated and processed into useable intelligence, it is disseminated to the various users. This is a distinct node because dissemination of the processed intelligence is a deliberate process that involves the actual decision to disseminate the intelligence to the users.	**Link 14:** This link depicts two possibilities: (1) the users closing out the requirement for further collection (the requirement has been satisfied), or (2) additional requirements being levied against the S2 for coverage, based upon what was disseminated to users, or new requirements developed by the user. **Arc 15:** Although part of the dissemination process, node D has the capability of sending processed intelligence directly to the user. For example directly from ASAS to MCS, or the ASAS view displayed on the SDS screen. **Arc 15a:** Similar to Arc 15, dissemination of processed, targetable data is electronically sent to the AFATDS by the ASAS. This process can also be done manually, with processed, targetable data manually provided to the targeting node. **Link 13:** Traditional dissemination means.
Node F, targeting node, AFATDS: This depicts the targeting node of the brigade. The primary system at this node is the AFATDS in support of the FSO. This node has several other links which are not depicted with the firing batteries, battalions, and higher echelon elements.	**Arc 15a:** The standard means by which the targeting node will receive data for the conduct of targeting planning and execution. This depicts the node receiving processed intelligence via dissemination from the intelligence system. **Arc 11a:** The electronic interconnectivity the targeting node (AFATDS) has with both the processing node (ASAS) and the preprocessing node (CGS). The AFATDS is capable of sending requests to both the ASAS and the CGS and receiving messages with targetable data from both of these systems.

	Arc 17: This shows the link between the battle management node and the targeting node. This is done either through interaction between the FSO, S3, commander, or via electronic means between AFATDS and MCS. **Arc 16a:** This depicts the targeting node requesting information or intelligence from the directing node (S2) required to support the brigade targeting mission.
Node G, Battle Management: This node consists primarily of the S3 and the commander conducting the battle management functions of the brigade. This includes controlling and managing all aspects of the brigade's operations, focusing on maneuver elements and combat systems. Systems in this node include the MCS and the various view screens or monitors.	**Arc 16:** The battle management node interfacing with the S2 in determining requirements required to support the battle management function. **Arc 17:** This arc (as previously described) depicts a link between the battle management node and the targeting node. This is done either by face-to-face coordination or electronically with AFATDS or MCS.. **Arc 11:** The battle management section (commander and the S3 Section) receives a view of the information being formatted by the preprocessors and the intelligence formatted by the processors prior to the information completing the entire intelligence process within the intelligence system. This is done with the RWS, SDS or by the interconnectivity between ASAS and the MCS. **Arc 16:** The battle management section interfacing with the S2 to determine requirements. With the inclusion of the preprocessors and enhanced collection systems at the brigade, it is readily evident that the S3 or commander will be significantly more involved in the direction and control of the CGS and associated collection systems.

Fig 16. The targeting and battle management functions model with corresponding descriptions.

Analysis and Discussion

Execution of the battle management and targeting functions within a brigade are complex and difficult functions. The staff receives information from a variety of sources and attempts to form the information into a succinct format readily useable by the commander and other relevant elements. This is done in order to form a clear and concise picture of the battlefield. As the Army's keystone doctrinal manual, FM 100-5, states, leaders "must assimilate thousands of bits of information to visualize the battlefield, assess the situation, and direct the military action required to achieve victory."[7]

Conducting analysis of this model is more complicated due to the numerous links and arcs depicting the numerous methods by which information can be passed and received. Another factor is that the targeting node and the battle management node can impact, at several different nodes, within the process. The analysis of this model will focus on the areas as outlined in the model and the outline which can be improved by changes in the CGS architecture or doctrine.

A factor in this model is in the number of links leading to and evolving from the preprocessing node. This has potentially critical information bypassing the processing node and provided directly to the targeting and battle management nodes. While this does facilitate a faster movement of information throughout the model, the end result is the dissemination of raw intelligence. This may quickly lead to the internal brigade system having up to five different views and subsequent interpretations of the battlefield at the different nodes.[8] While this results in a faster dissemination of information, it may

not always depict an accurate picture of the battlefield required to support the targeting and battle management functions.

Another interesting issue is that several nodes have direct connectivity, or impact upon, the directing node. This is done by face-to-face coordination, or digitally via MCS or other means. This shows the directing node (S2) directing collection systems, managing the preprocessing nodes, and satisfying requirements generated by lower echelons, the targeting node, or the battle management element. In regards to the CGS, an element of the S2 section or ACT must actively task and monitor the output of the CGS. As the architecture and doctrine is now designed, this will require more direct management since the operators in the CGS are not analysts, but basically only operators of the system. They are trained to simply respond to requests provided by the directing node (S2 or ACT). This results in more overall supervision and refinement of taskings based upon changes in the brigade's mission, or changes in enemy activities. This increases the workload on the already overloaded S2 and ACT elements.

An additional issue is the significant amount of dependence placed upon the ability of the E-8C, in conjunction with the CGS, to provide a total picture of the current enemy situation. The imagery provided by JSTARS is not an end product. It is imagery. While in the case of some imagery, it is easy to look at the imagery and deduce what the meaning is. Or is it? An imagery analyst might on occasion be capable of looking at the imagery, be it MTI, FTI or SAR, and provide a wealth of information not readily obvious to the CGS operator, commander, or members of the brigade staff who are not trained extensively on imagery interpretation. Even if imagery analysts were located in the CGS, the large amount of imagery the CGS receives from the E-8C, UAV, and other imagery

sources, could quickly overwhelm analysts in the CGS or ACT. The incorporation of automated and semi-automated target recognition tools may assist in alleviating this problem. More importantly, there is a need to develop the operational target cueing techniques and procedures to aid the analyst in using an integrated approach for detecting, discriminating, classifying, and tracking both stationary and moving targets.[9]

The end result is that the CGS does contribute to the execution of the battle management function. Although, there are significant concerns reference the fact that the CGS is primarily being used to provide a non-correlated or unprocessed view of the battlefield to the users, it does provide the commander and staff a useable picture of the brigades area of operations and interest. Modifications, as recommended in chapter 6, will only enhance this capability resulting in better and more accurate support provided by the CGS.

The CGS as a single system is currently not capable of supporting the targeting function in support of brigade operations. The MTI or SAR, provided to the CGS by the E-8C, does not provide the resolution required for targeting by brigade systems. The majority of the SIGINT systems, which provide input to the CGS, additionally do not provide the needed targetable data. The IMINT capability in receiving SID imagery is not timely reference mobile targets and is only useful for targeting fixed installations such as logistic sites or other more permanent potential targets. The UAV video feed provides the most timely and accurate targeting feed, but with the CGS operators not trained as analysts, they often cannot determine what the targets are, or provide the analysis required to support the time critical targeting mission. Therefore, without modifications the CGS information provided is ineffective as a sole source in supporting

targeting at the brigade echelon. If CGS information is correlated in the processing cell, it will provide a piece of the picture the ACT analysts can incorporate with other intelligence to better support targeting missions.

This model produced two significant issues, which if addressed and corrected will greatly improve the capability of the CGS in providing accurate support to battle management and targeting functions. These issues are discussed in depth in the following chapter.

Research Difficulties

Limitations as discussed in chapter 1 had only minor impacts on the preparation and subsequent results of research and the subsequent analysis. The constantly evolving doctrine and concepts were a challenge in attempting to establish a baseline from which start and conduct the study. While this was, and continued to be a difficulty throughout the conduct of the study, the effects were mitigated by including the results of testing conducted on the concepts of Force XXI and Intel XXI. Further negating limitations, the focus remained on the major tenants of the new doctrine, which are believed to be valid, and will not change substantially during future doctrinal revisions.

An initial significant challenge was in designing an adequate means by which to examine the key aspects of the CGS's architecture and doctrine that had the greatest impact upon the brigade's intelligence structure. The construction, description, and the subsequent analysis of the different models alleviated this challenge by providing a means to graphically depict CGS operations within the brigade's intelligence system. This allowed the author to study the models, conduct a step-by-step analysis, determine the relevant issues, and answer the questions posed in chapter 1.

Another difficulty was encountered when it was discovered that some of the available sources were classified. This primarily related to the CONOPS for JSTARS employment in support of Army operations. It was possible to mitigate this problem by focussing primarily on the CGS operations within the brigade. Even though, some unclassified extracts were incorporated when discussing and analyzing the link and doctrine between the CGS and the E-8C. This issue was further mitigated by slightly changing the initial focus of the thesis, negating issues that would have required classified sources. The author believes a classified study of E-8C and CGS interconnectivity, joint operations, and joint doctrine is warranted as CGSs are fielded throughout the Army.

Summary

Upon the completion of the analysis several key issues were uncovered:

1. The complexity of the overall intelligence process has been significantly increased with the addition of the CGS.

2. There has been a major increase of raw and processed intelligence received into the brigade's intelligence system.

3. The CGS, as a single system, does not provide readily targetable data.

4. While Force XXI and digitization have increased the ability to share information within the brigade, one single point within the intelligence system is still required as center point for the consolidated production and dissemination of intelligence.

5. Based upon various limitations, the CGS as a single system is not capable of

providing a complete picture for accurate use for battle management. The CGS must be used in conjunction with all available intelligence in order to provide an accurate intelligence picture.

6. The CGS operators require additional analytical capability or training. This specifically relates to the ability to conduct analysis on imagery and electronic signals related products.

7. Changes to the CGS and the brigade's intelligence system architecture and doctrine will negate the major issues raised.

None of the listed issues are considered as potential showstoppers to placing the CGS into the brigade's intelligence system. Rather, the technology inherent in the CGS, and the collection systems that provide data to this system, are notable in their ability to improve the brigade's intelligence capability. Nevertheless, modifications in the construction of the intelligence system in the brigade and corresponding changes to the CGS are required in order to fully maximize the potential that this added capability provides to the brigade. These recommendations are discussed in detail in chapter 6.

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[1]Harold E. Mahan, *Benson J. Lossing and Historical Writing in the United States 1830-1890*, ed. Benson J. Lossing (Westport, CT: Greenwood Press, 1996), 45.

[2]An even more accurate analysis would require a substantial amount of time and resources. To depict a system operating within the intelligence system, a researcher would need to conduct and end-to-end analysis. Starting with the request and tracking the flow of the request and the subsequent intelligence all the way from the source to the user. This would involve using raw data from actual exercises or operational events.

[3]The concept of the single thread node was provided by an interesting article prepared by the RAND Corporation in evaluating intelligence systems that support deep fires. The author modified the single thread model slightly to fit the architecture typically found in the army prior to the introduction of digitization and Force XXI tenants of doctrine.

[4]Some of the issues discovered during analysis are relevant to both models. These issues will be discussed in conjunction with the model upon which the most significant impact takes place. For example, if an issue has more relevance to model three, it will be addressed as an issue with that model. If it also has an impact upon model four, it will be mentioned as such, and the reader will be referred back to the previous model for reference.

[5]This quote was overheard by the author during an after action review at NTC in 1988. He does not recall the individual who made the statement.

[6]James P. Marshall (MAJ, USAF), *Near-Real-Time Intelligence on the Tactical Battlefield* (Maxwell Air Force Base, AL: Air University Press, 1994), 21.

[7]U.S. Army, FM 100-5, *Operations* (Washington DC: Headquarters, Department of the Army, GPO, 14 June 1993), 2-14.

[8]Each node could theoretically have a different view of the battlefield. The CGS operators view, ASAS or ACT view, battle management cell view by what is being depicted on the MCS and the SDS screen, targeting cell view as provided by the AFATDS, and the S2 from viewing UAV, CGS and ASAS displays.

[9]The Defense Advanced Research Projects Agency is running an advanced concept technology demonstration l an ACTD, called semi-automated IMINT processing. This demo seeks to reduce the image analyst workload for stationary target exploitation by a factor of a thousand. A similar ACTD is planned to wring out operational implementation of a moving target exploitation system. The end objective will be to synergistically exploit synthetic aperture and moving target indicator radar capabilities in a single, integrated concept of operations.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

> Victory smiles upon those who anticipate the changes in the character of war, not upon those who wait to adapt themselves after the changes occur.[1]
>
> Giulio Douhet

The raison d'etre of the intelligence community is to provide accurate and meaningful information and insights to consumers in a form they can use as they need it. If intelligence fails to do that, it fails altogether. The expense and effort invested in collecting and processing the information then have gone for naught.

The technical capabilities that the CGS provides to the brigade are essential to provide the intelligence support required to make Force XXI concepts successful. The end result of the analysis shows an overriding discrepancy in the way the CGS is merged into the brigade's intelligence system. TRADOC PAM 525-5 states that "success on past battlefields has resulted not so much from technological advances, but from innovative ways of considering and combining available and [sometimes] new technologies as they apply to warfighting."[2] It is not so much as what the technology brings to the battlefield (whether it be weapon systems, signal assets, or intelligence collection or processing systems) it is more critical in how the assets are utilized, fused into the system and in recognizing the strengths and weaknesses of the technology and systems. This is extremely relevant as applied to the results of the analysis conducted and highlighted in the findings which follow.

The overarching conclusions show that changes are required in the current doctrine and architecture of the CGS. Based upon the analysis, five significant issues

(reference the doctrine and architecture) were determined to be critical and require changes. If these issues are incorporated into the existing CGS architecture and doctrine, they will provide a much-improved CGS which is capable of supporting the brigade in the conduct of the surveillance, battle management and targeting functions more effectively.

Issues and Recommendations

The following issues are a compilation of findings based upon analysis of models three and four as discussed in chapter 5. In formatting these issues, the issue topic is listed first as based upon the analysis of the models, with external and internal impacts that affected the models supporting the development of the issues. This is followed by a discussion reference the current doctrine and architecture currently in place for the CGS. Next, a discussion of the issue correlates the analysis of the models in relation to the issue and relevant impacts. The final step is the recommendation for improvements or changes to the current doctrine and architecture of the CGS based upon the preceding issues and discussion.

Issue 1

Issue. The timeliness of the information flow within the intelligence system and the lack of a common picture between the preprocessor and processing nodes.

Current doctrine and architecture. Current doctrine shows the CGS as a distinct and separate system (node) providing data via message format to the ASAS and other nodes internal to the brigade's intelligence system. The S2 tasks the CGS directly (face-to-face) or via the ASAS. As stated in the current TTP; "the CGS operator workstations and the RWS can be connected to the ASAS either by LAN or hardwire connection to

receive taskings and pass intelligence reports."[3] Also, the CGS will display raw data "to the battle staff with minimal input from CGS operators. The battle staff will analyze and react to the CGS displayed information accordingly. The RWS, and/or remote monitors enable the battle staff to visually review NRT information."[4]

Discussion. The CGS preprocessor with all available collection systems (to include the E-8C) is the source for a significant portion of the brigade's picture of the battlefield. The ASAS as the processor is receiving input from division and all other internal and external collection systems, developing its "picture" of the brigades AOR and AOI. The CGS can pass messages to the ASAS, which are then parsed into the ASAS database, disseminated, or deleted. These messages are text and are limited in their capability of providing a complete picture to the processing node.[5] Theoretically then, two different nodes are depicting two different views of the battlefield. Single text messages provided by the CGS cannot provide the necessary information required in adequately transferring and correlating these two separate views.[6]

Future improvements in interconnectivity between the CGS and ASAS envision the CGS being capable of providing a steady stream of imagery to the ASAS. The ASAS analyst would then be capable of reviewing the imagery, switch back to ASAS related functions, and then enter the information the operator had detected while reviewing the CGS imagery. This improvement is considered inadequate based upon the requirement for speed and accuracy. This process is slow and cumbersome and does not meet the tenants of either Force XXI or Intel XXI. As stated in TRADOC PAM 525-XX, the goal is "to provide a shared common relevant picture of the situation."[7] In theory, the common picture has already become disjointed within the intelligence process in that two

brigade intelligence systems have two different pictures of the battlefield. While this may not be an initial concern, when the different views are provided to the users, numerous possible complications become obvious. The evident question becomes which view is correct and should be acted upon by the brigade commander or staff.

An additional element of this issue includes the capability of the processor (ASAS) to task the CGS for reports on specific areas of the battlefield. This once again is done by laborious text format messages prepared by the ASAS operators and sent digitally to the CGS. The CGS operator then opens the message, deciphers the tasking, and sets his screen appropriately to answer the tasking. This, as before, decreases efficiency and slows the efficient movement of information that happens to be, in this case, a request for information.

As can be seen in the model, there is a physical separation between the preprocessor node and the processor node. This (as discussed above) slows the passing of information, slows the tasking of the preprocessors by the processor, creates different views and perceptions of the battlefield, and overall creates a time lag in the creation of one common picture of the battlefield. Improvements can easily be made to increase the speed of interaction, although this current structure of two separate nodes, preprocessor and processor, will always create a time lag and inherently create two different pictures of the same battlefield.

The CGS as now configured is being used to provide a view of the battlefield and pass information to the processor (ASAS). The ASAS is used to develop the brigade's correlated common picture of the battlefield. In a sense, these two systems are providing a separate but equal function in providing a view of the battlefield. This would not be a

significant issue if the CGS was not capable of providing its view directly to the user. But, with the requirements for speed and efficiency dictated by Force XXI and the new enhancements provided by digitization, this becomes a serious issue which must be addressed.

Recommendation. The preprocessor node and the processor node need to be incorporated into one common system or node. The overall process will be enhanced significantly if a portion of the CGS is merged into or with ASAS or ASAS into the CGS. The view of the battlefield that the CGS provides is significant to the point that the entire view it provides needs to be an inherent part of the processing node. This can be done by merging the preprocessing node with the processing node (a portion of the CGS workstations with ASAS.) In effect, ASAS and the CGS will become one in the same. With CGS workstations capable of conducting ASAS operations, this would provide the operators the ability to quickly and easily merge the CGS view with the ASAS view of the battlefield. This enhanced processing node will also provide the capability of fusing UAV imagery received by the CGS in order for it to be viewed, analyzed, and concurrently correlated with the wealth of other information resident in this combined preprocessor and processing node.

In this new design, elements of the existing preprocessing node will basically become more of a collection control element. This includes a portion of the CGS maintaining interface and communications with the E-8C and the UAV GCS becoming solely a UAV control station. All relevant data would now be centralized within the processing node, eliminating the delay in passing of information, taskings, and the previous concern of two different views of the battlefield.

An added benefit will be that the picture, or view provided to the users, will come from only one source in the intelligence system, that being the combined preprocessing and processing node. This prevents two separate intelligence pictures of the battlefield being displayed and potentially acted upon incorrectly within the brigade staff structure. The processing node will now be capable of presenting a single correlated and processed intelligence picture of the battlefield for use in supporting the surveillance, battle management, and targeting functions. Previously, with the CGS view provided to the users via the SDS or other type of display screen, the users were viewing raw intelligence, necessitating time consuming analysis of the displayed information by the commander and staff. With a consolidated view provided by one centralized node, the view can be annotated and displayed as analyzed intelligence, enabling the commander and staffs to more quickly react to the one true intelligence picture provided.

The final benefit this change in doctrine and architecture will have on enhancing the brigade's intelligence system and increasing the utility of the CGS, is that the processed intelligence produced by the processor is more current and accurate. The processing node will be able to present a more timely correlated picture of the current situation via the dissemination node to both the users and the S2. Based upon this the users will be capable of reacting to a processed surveillance picture and the S2 will be able to determine if the intelligence is accurate and therefore more quickly determine additional requirements without viewing two different pictures of the battlefield.

To enable this concept, simple changes to software are required. No significant changes to existing hardware are required because both ASAS and CGS software operate on UNIX (SunSpark) based systems. The most significant software change will be

required in making the CGS and ASAS software interactive. This enhancement would also require significant cooperation between two separate PM's and contractors. But overall, the concept is fairly simple and it is the author's contention that this change could be incorporated fairly quickly. The end result satisfying the tenants of Force XXI and Intel XXI and enabling the brigade to react quickly to any situation as provided by the single correlated intelligence picture.

Issue 2

Issue. Tasking and responsiveness of the E-8C to brigade operations.

Current doctrine and architecture. Current doctrine does not provide a method to control the tasking of the E-8C when there are more than one CGS interfacing with the E-8C. Each of the six CGSs deployed in the division has a direct communication link to the E-8C, providing the capability for each CGS to directly task the E-8C.

Discussion. The E-8C is considered as a theater asset. As stated in the current doctrine "The primary mission [of the JSTARS (E-8C)] is to provide dedicated support to the corps commander and other ground commanders under the overall direction of the joint force commander (JFC)."[8] Staying within the constraints of this thesis, the models depict the brigade as part of the deployment of only one division. Given this, the E-8C is servicing the division, the maneuver brigades, and the other CGSs in support of the aviation brigade or other supported element as directed by the division G2 (six total and different CGSs). As described earlier, the more taskings the E-8C has for specific coverage such as SARS, FTI, or SS, the radar swath slows, providing all CGSs with less imagery and decreases the ability of the operators to locate and track moving targets. This will have a significant impact upon the CGS operator supporting the brigade in his

ability to track the close-in targets of significance to the brigade. This problem becomes more magnified when operators are attempting to track a small number of moving targets.

The aspect which must be considered, is how the brigade S2 tasks or requests specific taskings against the E-8C. It is not clear if the S2 needs to pass requests through the division to the E-8C, or if the S2 can task his CGS to request specific coverage directly from the plane. Division collection management controlling the tasking from the different CGSs to the E-8C will slow the overall process, but allow the division to manage the tasking rate to the plane. On the other hand, with each CGS independently tasking the plane the large number of taskings have the potential to seriously slow the radar swath rate and subsequently the collection of timely imagery. This degrades the amount of imagery and potentially makes it extremely difficult for CGS operators to track specific targets, causing the operators to possibly miss critical information which may have a serious impact upon the maneuver brigade.

While this may not be a significant issue at corps or higher echelons, it is a critical issue for the CGS in support of brigade functions. At the brigade, the location and movement of just a few vehicles can be critical. This could relate to the movement of an enemy's firing battery, or the movement of a tank platoon. Less available imagery seriously impacts the operator's capability in tracking smaller numbers of vehicles. If the radar swath is slowed to over three minutes, a small group of vehicles could have moved over two to three kilometers. If the terrain is undulating or heavily vegetated, the vehicles may be only sporadically visible. This makes an operator's job of tracking these vehicles extremely difficult if imagery availability is limited due to a large tasking rate levied against the E-8C.[9]

Recommendation. Architecture or doctrine must be implemented to provide a centralized point for requests from the division's CGSs being sent to the E-8C. One method would be to designate one CGS at the division as the control or master CGS through which all requests from other brigades or division CGSs to the E-8C are processed, prioritized, and then sent to the E-8C. This will prevent a slowdown of the imagery provided to the CGSs and will provide a centralized node which can determine and dictate priorities based upon the current battlefield situation. To depict this in models three and four, node c would now have a link or arc back to link h, or the CGS at the division. The brigade S2 would then coordinate with the division G2 for priority and then could task his CGS for specific coverage without impacting the overall radar timeline.

While in some aspects, this will slow the overall tasking and responsiveness of the E-8C. But, the impact caused by a decreased availability of imagery to the CGSs can be considered as potentially more significant. The collection manager will establish priority of tasking from each CGS based upon the current mission and ground situation. Added software in the controlling CGS will allow the operator to quickly receive, process, and execute the taskings in accordance with the priority established by the division collection manager. The collection manager will also dictate the radar swath timeline required and request that the E-8C maintain that timeline. This would then establish the number of requirements the E-8C would be capable of executing without affecting the established timeline, thereby maintaining an adequate flow of imagery to all division CGSs.

This is a fairly easy fix. Communication links are already established in the current structures and a simple software addition could make this feasible. Additional

coordination would also be required between the collection manager and the E-8C, but this could be done with a simple up-front message at the start of each E-8C mission. This message would establish the priority of tasking execution and establish the required radar swath timeline to be maintained.

Issue 3

Issue. Lack of operator analytical capability in the CGS.

Current Doctrine and architecture. As outlined in the CGS TTP:

> The modified table of organization and equipment (MTOE) for a CGS is six MOS 96H (imagery ground station operator). This crew consists of one E-6 CGS team leader, one E-5 assistant team leader, and four E-4/3 CGS operators. The CGS crew is trained to operate the system, provide hard and softcopy products, establish interfaces, and provide rudimentary analysis of JSTARS imagery products. Analysis is limited to determining if MTI represent moving vehicles or is simply ground clutter, and determining ground patterns which may define certain types of enemy activity (assembly areas, etc.). MOS 96H soldiers are not trained as order of battle, imagery, or all-source intelligence specialists. Detailed analysis of correlated CGS products and target development activities are conducted by the supported unit's intelligence and targeting staffs.[10]

Discussion. As stated quite clearly in the TTP, MOS 96H soldiers, the operators of the CGS, are not trained as analysts. As the analysis was conducted of the models, it became evident, that based upon the current structure, with all the different intelligence feeds provided to the CGS, this is an ideal location for an intelligence analytical capability.

The current operators (96Hs) are trained to simply operate the system, although they do receive some training on conducting rudimentary analysis of MTI data from the E-8C. Beyond that, they receive only very basic training on the interpretation of imagery, signals intelligence, or basic intelligence analytical capabilities found in the current intelligence analyst which is listed as an MOS 96B.[11]

With the capability of the CGS to receive information from multiple and varied sources comes the implicit requirement for the operator to understand, correlate the data, and determine whether the additional collection sources provide confirmation of previously provided information (this typically being E-8C imagery).[12] The operators need to be able to look at and understand a SID image product received, or be capable of understanding the significance of a SIGINT report and correlate this with other available collection information into one picture or report. Failure to do so can be attributed to a lack of training and experience in such requirements. This is a typical and central activity for intelligence analysts, but is not currently demanded or expected from the current CGS operators.

During testing conducted on the CGS over the course of the past two years, it was noted that the CGS operator is ostensibly (as per doctrine) not required to perform analytical functions. Yet, many of the taskings the CGS operator receive are related to detection and tracking of specific types of vehicles or units, with an implied operator ability to differentiate between unit, type vehicle, enemy intentions, and other possibilities. As stated in an OPTEC *CGS System Analysis Report*:

> He [CGS operator] frequently needed to use judgement to analyze the tasking in terms of what procedures were most likely to result in a successful answer to the tasking. He needs analytic capability in order to decide what imagery will best assist him in various types of taskings. He needs a clear understanding of the information that needs to be included in a report in order to make it useful to an intelligence officer.[13]

Another factor is that if the current architecture continues to provide external links to the standard intelligence system, an analytical capability within the CGS is essential. Current CGS operators are not capable of interpreting to any critical detail any of the intelligence products available. This basically does not fit within the tenants of Force

XXI or Intel XXI or any other current doctrines. If the intent is to collect, process, and disseminate intelligence at an ever-increasing speed, why are intelligence analytical capabilities excluded from the CGS crew? An analytical capability would provide the means to quickly interpret, analyze, and then disseminate the various intelligence feeds provided to the CGS.

Alteration of the current doctrine and architecture in accordance with the previous issues and recommendations do not significantly alter the requirement for an analytical capability within the CGS. If the CGS is incorporated into a single processing node in conjunction with the ASAS, increased analytical capability would still be required. The mix of MOSs provided in the operators of the CGS would significantly enhance this node, and provide an intrinsic analytical capability to this node and enhance the overall brigade level intelligence system.

This is not a new issue. This topic has surfaced several different times during the development of the different versions of the CGS. Each time it was raised, the Intelligence Center and School decided to maintain the current status quo. This can partially be attributed to the overall background behind the development of the CGS specific MOS.

The initial MOS 96H was developed to act as a "right seater" in the discontinued MOHAWK intelligence imagery collection platform. The 96H flew on the aircraft and analyzed the MTI type data being collected by the aircraft and controlled the functions of the on board radar. Other 96Hs operated in the ground station that linked to the MOHAK. When the MOHAWK was discontinued in 1994, the MOS was designated as

the operators for the various versions of the GSMs then in existence which have evolved into the CGS.

The 96H therefore is a legacy MOS, having evolved to its current position of operating the CGS. When the previous GSMs simply received MTI data from the E-8C, the 96H MOS was relevant and adequately served its purpose. But, with the evolution of the ground station into the CGS, with multiple intelligence collection sources, the MOS, as currently trained is no longer adequate.

Recommendations. Train and man the CGS with trained analysts. For the CGS to be successful, a mix of different analytical capabilities are required. A possible mix could be one SIGINT analyst, two imagery analyst and three trained 96Hs who would be primarily responsible for CGS operations and conducting analysis of E-8C specific products. This would provide a significant capability to the preprocessing node and intelligence vice simple information. The end result is a capability to thoroughly analyze all collected information provided by not only the E-8C, but all collection sources linked to the preprocessing node.

Simply put, the MOS 96H is not trained and therefore not capable of effectively correlating all the different collected information into a readily useable product. He is not sufficiently trained to understand the imagery from sources other than the E-8C and has no understanding of SIGINT information. Bottom line is that the system has evolved, but the operators responsible for operating the system have not.

The Intelligence Center and School appears, to once again, be opposed to this recommendation. The training of the additional analysts required would be expensive, SIGINT, IMAGERY and 96B intelligence analysts all require a top secret (TS) level

clearance (at an estimated additional cost of over $10,000 per TS clearance), additional training would be required to operate the CGS extending training time, and the overall pool of qualified recruits is currently limited. Therefore, while this is a viable recommendation, current budgetary and qualified soldier availability will likely result in no change to the current manning issue.

Issue 4

Issue. Inability of the CGS to provide targetable data to the CGS.

Current doctrine and architecture. The overall process and interconnectivity of the CGS with the targeting node is similar to the interface with ASAS as described previously. Based upon the CGS *TTP*, "the AFATDS can be connected to the CGS via LAN, or direct wire connection. The AFATDS workstation can also be placed in close proximity to the CGS RWS where information is passed between the two operators verbally or visually. If electronically connected, the CGS can digitally transmit message to AFATDS."[14]

Discussion. It was recommended previously to incorporate the CGS and the ASAS into one processing node in order to produce one correlated picture of the battlefield. This issue, related to the targeting function, lends more credibility to that recommendation.

As depicted in the models, the CGS has the capability of interfacing directly with AFATDS via formatted message formats. The CGS receives a tasking from the AFATDS, locates the target, and then sends the information back to the AFATDS. While this does take time, a more significant concern is in the ability of the CGS operators to provide data to the AFATDS, which is accurate and targetable by brigade assets.

Based upon recent testing conducted with the CGS, it was determined that the CGS was not capable of providing targetable data for brigade fire support assets against either moving or fixed targets. As stated in OPTEC's *CGS System Analysis Report*, the CGS failed in its ability to conduct targeting missions against fixed targets because of the "E-8 Sensor Platforms inability to provide adequate SAR resolution to allow the CGS operator to locate and report on fixed targets. Operators were able to successfully locate and report [fixed target data] on 15% of the taskings submitted to them."[15] This demonstrates that the CGS cannot provide the targeting node adequate and accurate data upon which to conduct fire support missions.

A second aspect of targeting support provided by the CGS is information on moving targets. Similar to the fixed targets, the CGS has been proven to be incapable of providing targetable data against these types of targets.[16] Based upon the *CGS System Analysis Report* from OPTEC, the CGS was not capable of supporting this type of targeting mission because of the "operators' inability to accurately report on moving targets. Operators were able to successfully report on 34% of detected moving targets." [17] This, as with fixed targets, once again shows the CGS as being unable to provide adequate and targetable data with a high degree of confidence.

The CGS provides only simple preformatted messages to the AFATDS. This takes time and results in the potential of delaying the passing of time critical targeting data from the CGS to AFATDS. Although, as discussed above, the current targeting data provided by the CGS is not targetable by brigade systems, the capability to share the respective views would enhance and speed the overall process of sharing information and taskings.

With UAV connectivity to the CGS, it is possible to determine a more accurate location and specifically identify potential targets. If the UAV is used in conjunction with the other intelligence collection information received by the CGS, this would be an exception to the inability to accurately depict the location of the targets.[18] The CGS can view the flight path and imagery of the UAV on the CGS internal workstations. The information is dependent upon the operators to either pass the view to other nodes, or pass the data via message format to the AFATDS. But, the author contends that this correlation would be better handled and coordinated if conducted in the processing node in conjunction with trained analysts.

A current limitation of the CGS in relation to the UAV is the inability of the CGS to share its current view with the UAV Ground Control Station. With the current concept being that the imagery provided by the E-8C is key in focusing other collection platforms to specific areas, this is a glaring oversight in capabilities. While the MTI and SAR provided by the E-8C, SIGINT and other imagery information provided by other collection platforms considered as inadequate for targeting, the UAV has assumed an increased role in being the key targeting asset in the brigade. Currently the UAV is directed to targets by the S2 or the ACT, in order to add clarification to information provided by other sensors, or to answer a specific request from the targeting or battle management nodes. The S2 then, via voice, coordinates with the UAV ground control station to move the UAV to the specified location. With the primary source of directing the UAV being the information provided by the CGS, the UAV should have ready access to the CGS view in order to more accurately control the UAV to the correct location.

Recommendation. Based upon these results, it is not prudent to provide the CGS with the capability of directly interfacing with the AFATDS in providing targeting data. With limitations in providing accurate targeting information, it is more prudent to have the information correlated in the processing node in order to develop a more accurate targeting picture. Therefore, as discussed in the previous issue, forming a single processing node from which all intelligence radiates and all requests for targeting data are received will improve the targeting function. This will provide more accurate target locations that can be disseminated to the AFATDS for the conduct of targeting.

If the CGS (with its link to the E-8C) capability of providing targetable data is improved in the future, the current process with the AFATDS in tasking the CGS for information and the CGS responding with the requested information via formatted messages would be inadequate. In this age of digitization and the common systems provided by ATCCS, the capability of each of these systems to share their respective views with each other should be examined. In other words, the CGS would be capable of sending current imagery to the AFATDS (be it MTI, SIGINT locations, or UAV imagery), while the AFATDS would be capable of sharing its view directly with the CGS. Of course, this is only valid if the capability of providing accurate targeting data by the CGS is resolved.

Improvements in the accuracy of information provided to the CGS by the various collection platforms can be expected to improve over the next few years. Ongoing modifications to the E-8C radar are taking place with the goal of providing enhanced resolution on both moving and fixed targets. Even though, the recommendation to integrate the CGS with ASAS to form one node remains valid. If the E-8C radar

eventually provides targetable data, it will only decrease the amount of time this node must correlate this data with other available sources. In some cases, this node would simply pass the CGS view directly to the AFATDS for immediate targeting.

In the meantime, the ability of sharing each systems view remains an issue. Even if the data provided by the CGS is currently inadequate for targeting by brigade organic assets, targeting by Army or Air Force aviation platforms is plausible. The accuracy provided by the CGSs collection feeds meets the criteria for both helicopters and Air Force ground attack assets. With a live view provided by the CGS to the AFATDS, the FSO would be capable of coordinating with the Air Force or aviation officer in directing and executing attacks against the targets depicted on the AFATDS screen as provided by the CGS.

The ability of the CGS and AFATDS to share respective views is a relatively easy fix. As with ASAS, both software systems operate on similar computer based systems. Simple coordination between the respective PMs, TSMs, and contractors reference software modifications could make this recommendation a reality.

An additional recommendation is to provide the ability of the CGS to directly share its view with the UAV ground control station. This will enable the UAV operators to better steer the UAV to areas of interest as shown by the MTI, SAR, SIGINT, or imagery provided by the CGS. The UAV operators will be able to actually see the location and in the case of moving targets, make required adjustments to steer the UAV to the correct location. A further enhancement would be to provide the capability to the CGS operators to annotate on the screen the desired look area on the view provided to the UAV GCS. This would dramatically enhance accuracy and speed of the UAV in

responding to a tasking. If done in conjunction with a combined preprocessing and processing node, this process would be even more effective.

Issue 5

Issue. Battle management view provided by the CGS is not complete.

Current Doctrine and architecture. The CGS has connectivity with the battle management node directly via a display screen (SDS) showing the CGS view or by the RWS which can be located in the battle management node. As stated in the current doctrine, the CGS will support the

> battle management across the entire battlefield spectrum. The ability to receive multiple sensor feeds enables it to support the warfighter's battle management concerns in a variety of combat situations. The correlated display of near real time information with processed IMINT and SIGINT products provides the commander a clear and accurate picture of the battle space.[19]

Discussion. Because of success at both the NTC and the AWEs, the majority of commanders and staffs are demanding that the picture of the battlefield provided by the CGS be displayed in the TOC to provide support in conducting battle management. (They want immediate and constant access to this information.) This is done by the CGS in providing a screen view of what is being depicted on the CGS workstations to the battle management node's SDS or RWS. The information provided is manipulated by the CGS operators, showing different views and the different intelligence feeds, as requested by the commander or staff. The typical intelligence depicted upon the screen is the E-8C MTI data and on occasion UAV video.

In a fairly non obscured battlefield such as flat desert terrain or thinly vegetated areas, the CGS view provides a fairly accurate depiction of enemy vehicles movement While in a heavily forested or mountainous terrain, the E-8C radar is significantly

masked by the vegetation and the terrain. This then would only provide the CGS and the commander and staff only glimpses of enemy movement. The incorporation of the UAV's "postage stamp" view and other intelligence feeds into the CGS would provide additional information, but the staff and commander are not provided with a full and complete picture of the battlefield. This may result in commanders and staffs making decisions based upon the partial view of the battlefield as provided by the CGS.

An additional problem with this is that the commander and staff are being provided a view of the battlefield depicted by a montage of sensor information from the CGS on the SDS. This can include UAV imagery, MTI, and SIGINT information displayed at the same time on one screen. This makes the battle management node conduct on-the-spot analysis. This causes the commander and staff to determine what each depicted intelligence collection source means, determine the significance, and they may not always interpret each different piece correctly. If the preprocessors and processors were incorporated in one processing cell, the analyst would be capable of producing and presenting one correlated and complete picture of the battlefield to the commander and staff. The processing cell would be capable of providing selected views of fully correlated intelligence to provide the best and most accurate view of the battlefield to the battle management node.

At times, a specific collection asset will be providing the critical picture of the battlefield. The processing node, working in conjunction with the battle management node, can then select this feed and provide it directly to the battle management node via the SDS or other viewing screen. As these specific feeds or views are provided, the

processing node can update it with other intelligence so that the battle management node can directly view it and be assured of receiving processed intelligence.

Recommendation. Incorporate the CGS into the processing node. At this node, analysts will be capable of constructing a complete picture, which can be used for the conduct of battle management. The analysts will have the capability to select one of several different intelligence feeds, annotate it with additional information, and digitally provide it for viewing by the commander or S3. This will negate the commander and staff from conducting on-the-spot analysis and will provide an intelligence picture from one integrated node.

Additional rational, which supports this recommendation, is the fact that the current number of E-8Cs is limited. As of early 1999 there are only three functional E-8C platforms available. Therefore, availability of constant E-8C coverage is not guaranteed. Without the E-8C, the usefulness of the CGS with the current MOS 96H is of greatly reduced value. The view provided to the battle management node or the support to the surveillance and targeting functions is significantly limited. If the CGS was integrated with ASAS into one node, the collection sources provided could be more readily correlated into one accurate picture.

Summary

Five significant issues were discovered during the conduct of analysis, with several corresponding suggestions for potential fixes listed. It was determined that the CGS is marginally capable of supporting surveillance and battle management and currently is incapable of supporting the brigade targeting function. A key shortcoming was discovered in the formation of a separate preprocessing node and the inability of the

CGS to readily share actual products with the ATCCS systems and other systems. Overall, these issues are significant and demand consideration of the recommended changes as listed.

Recommendations for Further Research

The venue for continued research on the various topics and issues raised in this study are unlimited. Each collection system, processor, preprocessor and the related ATCCS systems warrant individual studies. The new brigade structure and its organic intelligence system are valid topics for several studies looking at different sub-components of each. Therefore, the following recommendations for further research are only a subset of the possibilities that this study has uncovered.

Future studies on the relationship between the Air Force and Army in coordination of this joint system are relevant. The history of the trials and tribulations between the two services in the building and coordination is relevant since the future of the military indicates that joint operations are the wave of the future. With limited recourses and the ever tightening budget, the processes in developing joint systems, their purpose, and the coordination required between separate services are of concern. The history behind the development and subsequent utilization of the JSTARS system will hopefully provide recommendations to improve the overall developmental and acquisition process.

Another area of interest is the Army's ongoing struggle to build and field a functional UAV system. The Army has been wrestling with developing and fielding a UAV since the early 1980s. Even during the course of this study, the Outrider UAV system was cancelled based upon multiple failures at various tests. Prior to that the

Hunter UAV program was cancelled after over thirty systems were built.[20] Currently it is unknown which (if any) system will be the replacement. Even though the Air Force, Marines and the Navy, to include 36 different countries have effective UAV programs established and in use today, the Army continues to languish in developing and fielding any accepted UAV. Since the UAV has been proven to be of significant value and the fact that Force XXI and Intel XXI tenants are dependent upon the eventual fielding of a UAV system, this is a very topical issue worthy of detailed future research and subsequent publication.

The final recommendation is to conduct an in depth study on the brigade's internal intelligence system. With the numerous changes not only the brigade, but the intelligence system currently underway, this is of immediate interest to the Army community as a whole. The focus should be on conducting a study of the components of the intelligence system and the ability of each element, as a sub-component of this system, to support effectively the brigade in the execution of each specific mission (defense, offense, etc.). The overriding question is; can the proposed intelligence system provide adequate support to the maneuver brigade? This study should not only take into account the different missions, but the various types of enemy forces and different terrain the brigade may encounter in the future. Sub-components of this issue could easily be a separate and significant study unto themselves.

Conclusion

> Do not repeat the tactics that have gained you one victory, but let your methods be regulated by the infinite variety of circumstances.[21]

Sun T'zu

The research question which began this study asked the following question: What is the best architectural and doctrinal structures for the common ground station (CGS), in order to provide the best intelligence and targeting support to maneuver brigade commanders? Since it is impossible to entirely rewrite the existing doctrine and architectural concepts for the CGS within the confines of this paper, the significant issues uncovered during the analysis were addressed. Based upon the detailed research and analysis, implementing the listed recommendations to restructure the existing architecture and doctrine will provide the best architectural and doctrinal structure required to effectively fuse the CGS into the brigade's intelligence system, subsequently creating an effective system.

There are, of course, many other minor issues not addressed in this paper. These will likely be solved over time as the CGS is fielded and used by the maneuver brigades. It is taken for granted that not all emerging doctrine for a new system is perfect. A valid assumption is that future problems and issues reference the current doctrine and architecture will arise. The CGS TTP states:

> This living document [CGS TTP] is intended as a guideline. It is based on the best information available at the time of its publication. . . . The commander's employment of the CGS's multiple, complementary capabilities in a given situation, may or may not conform to existing doctrine or the confines of this document. Warfighters create and/or modify doctrine to accomplish their mission.[22]

Therefore, this study should be considered as a snapshot in time of the CGS and its related architecture and doctrine. Some of the issues and related recommendations will likely be incorporated over time, while others will languish and be revisited in future studies and after action reviews conducted after exercises or actual deployments. In some cases, units supported by the CGS will alter existing doctrine to better incorporate the

system into their respective intelligence system. The bottom line is that the above issues must eventually be addressed. This may simply that mean operators and users are aware of the issues and the related shortcomings and overcome them as best they can, or the intelligence community makes the corrections as recommended. Either way, this study is simply one of the first reference the CGS, with only the results of future wars determining if the issues raised in this paper are valid and if the CGS will be overall successful in providing the required support to the maneuver brigade.

In the end, the concept of the CGS supporting the brigade is doctrinally sound. Although, the doctrine and the architecture of the CGS and the brigade warrants a major revamp in order to make the incorporation of the CGS into the brigade effective. The overall changes required not only involve a revamp in technical (software capabilities) with the CGS, but also involve a major change in the way the preprocessing and processing node are organized and structured. Therefore the changes required are not so much a simple change, but involve a restructuring of the overall intelligence system within the brigade. If this is done, the CGS, as a part of the brigade's intelligence system, will be effective.

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[1]Giulio Douhet, *The Command of the Air* (Washington, DC: U.S. GPO, 1943; reprint, Washington DC: U.S. GPO, 1983), 34.

[2]Headquarters, Training and Doctrine Command, Pamphlet 525-5, *Force XXI Operations* (Fort Monroe, VA: 1 August 1994), 1-5.

[3]Headquarters, Training and Doctrine Command, "Tactics, Techniques and Procedures for the CGS" (draft) (Fort Monroe, VA: 20 February 1999), 25 (hereafter cited as TTP CGS).

[4]Ibid., 27.

[5]During the course of a recent test, the ASAS was capable of portraying the imagery (as seen on the CGS screen) provided by the CGS. But, in doing this, the ASAS was not capable of conducting any other operations, meaning that the ASAS became in a sense a simple extension of the CGS view of the battlefield as provided by the picture provided by the CGS.

[6]Some units have placed the CGS RWS directly next to the ASAS in order to attempt to correlate information and to update the ASAS view in conjunction with the view provided by the CGS.

[7]Pamphlet 525-5, *Force XXI Operations,* 1.

[8]U.S. Army, FM 34-25-1, *Joint Surveillance Target Attack Radar System (JSTARS)* (Washington, DC: Headquarters, Department of the Army, GPO, 3 October 1995), 2.

[9]While this complicates the operator's job at the higher echelons, they will typically be interested in movement of larger formations of vehicles. Larger masses of vehicles increase the probability of detection even in heavily vegetated terrain with decreased radar swathe timelines.

[10]CGS TTP, 34.

[11]A MOA 96B is an intelligence analyst. He is trained to recognize formations, interpret enemy intentions, and all other basic intelligence analysis functions. This is the core intelligence MOS responsible for interpreting all the different information available and determining the current enemy situation and intentions.

[12]A concept forming within the intelligence community is that the E-8C provides an overview of the battlefield. It does not provide the specifics required. Therefore the E-8C is considered (in some circles) as a cueing platform, providing broad coverage which allows the intelligence manager to focus other collection assets against the reported information provided by the E-8C.

[13]Headquarters, U.S. Army Operational Test and Evaluation Command, "System Analysis Report for the CGS IOT&E" (draft) (Alexandria, VA: OEC, 30 March 1999), 2-72.

[14]CGS TTP 39.

[15]System Analysis Report for the CGS IOT&E (draft), 2-21. The inability of the CGS to support fixed targeting missions only 15% of the time is more a function of the E-8C than it is of the CGS. The SAR images provided by the E-8C to the CGS in conjunction with FTI do not provide the clarity required for the CGS operators to

accurately locate and identify the targets. But, since this is a capability the CGS is "advertised" as providing, it is included in this analysis.

[16]While the concept of conducting targeting missions against fixed targets is a relatively simple concept, the targeting process against moving targets involves a slightly different process. The CGS can track the targets and based upon the movement rate, terrain, and road network, the operator can send a message to the AFATDS operator with the predicted time the targets will arrive at a given point. The AFATDS operators then use and disseminate this information accordingly.

[17]System Analysis Report for the CGS IOT&E (draft), 2-21. As opposed to fixed targets, the inability to report accurately on moving targets is related specifically to the CGS and the operators and not the E-8C. Technical testing has proven that the radar is accurate to the point of supporting brigade level targeting missions.

[18]The UAV provides a video feed and telemetry data to the CGS and to other remote screens (the SDS or other remote screen). While the imagery is in the strictest sense an accurate depiction of the target, the telemetry shows only the location of the UAV and not the target. Some analysis is required to determine the actual grid of the target.

[19]CGS TTP, 23.

[20]These Hunter systems are currently in storage at a contractor warehouse in Sierra Vista Arizona. It is possible that the Army may re-look the Hunter program and possibly reinitiate it.

[21]Sun Tzu, *The Art of War*, ed. Ralph D. Sawyer and Mei-chun Lee Sawyer (New York, NY: Barnes & Nobles Books, 1994) 23.

[22]CGS TTP, 34.

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